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THAT $50,000 PRIZE AGAIN.

That wily corporation, the Metropolitan Traction Company, has made another announcement in regard to its recent sham electric street railway competition, this time implying that the failure rests with the State Railroad Commissioners. President Vreeland on Saturday stated that "the company had waited until tired for some action on the part of the State Railroad Commissioners, who were to have been the judges in the matter, and had employed engineers to make examinations on its own account." It may be remarked that had these engineers examined the several thousand plans said to have been submitted, they could have made no award, as the time limit was such as to preclude compliance with the terms of the competition. The Railroad Commissioners are doubtless little satisfied with the part they have been made to play in the matter. The use of their names gave a stamp of good faith to the competition, and they would be fully justified in thinking that insult has been added to injury, as to their recent part of decoy they are made to assume the present one of scapegoat. It is rumored that the commissioners are preparing a public statement in which will be given in very plain terms their opinion of the equivocal use that has been made of the names of a State Department and State officials.

LEGALIZING ELECTRICAL UNITS.

The passage by the House of Representatives at Washington of the bill for the legalization of electrical units can be regarded as a recognition of the influence of the American Institute of Electrical Engineers and of the National Electric Light Association. Although the question of legalizing some of these units was before Congress after their adoption subsequent to the Paris Electrical Exhibition of 1881, the matter has received no encouragement until now, and the present comparatively speedy action may be largely ascribed to the action of the above two bodies at their recent annual meetings, united with the persistent efforts of Prof. Mendenhall at Washington. The units thus legalized are those adopted at the Chicago International Electrical Congress—the ohm, volt, ampere, coulomb, farad, joule, watt and the new unit of inductance, the henry. While these are now legal units it will be best to adhere to the characterization, "international," adopted by the Chicago Congress, in order not to confound them with the so-called "legal" units adopted at Paris in 1889, and the earlier ones known as the "B. A." or British Association units. The electrical units were originally in a bill before Congress which also included a number of other units relating to measures of length, weight and volume, but it seems that the new science has outdistanced its brethren in this as it has in so many other ways.

ISOLATED PLANTS FOR COUNTRY RESIDENCES.

While a considerable number of storage battery plants has been installed for the lighting of country residences, yet these are but a small fraction of what might be in use in view of the advantages of the electric light, where usually kerosene is employed as the illuminant. One of the reasons which has led such plants to be regarded with suspicion is the supposed necessity of a skilled or special attendant. Were it

made plain that the coachman and a stable boy, or the gardener and a laborer could in most cases successfully run such a plant without too seriously interfering with their other duties, the subject would be looked at in a more favorable light. In starting up a storage battery plant or shutting it down, the services of an intelligent man are necessary, but at other times it may be left in charge of any one who merely knows enough to keep up steam in the boiler and to keep the charging current constant by manipulating a rheostat. In several cases of which the writer has knowledge men of this character have had charge of plants, and in no case has there been any trouble. The more intelligent man does not need to be regularly present more than an hour or so in starting up in the morning, and a short while at the time of shutting down, a glance from him between times being otherwise sufficient, while the regular attendant may employ a good part of his time working on odds and ends, as the care of the plant will not entirely engross his attention. As such a plant would only be run two or three days a week the coachman or gardener would not find the extra duty too irksome, while the other man could probably in most cases be taken from his regular work without crippling it seriously.

THE INCANDESCENT LAMP PATENT AND BATE REFRIGERATOR CASE.

We have had inquiries in regard to the probable effect of a reversal by the United States Supreme Court of the point of law involved in the Bate refrigerator case, in respect to a patent which, under the application of the present interpretation of the law, expires before the decision is handed down. That is, what would be the status of a manufacturer of incandescent lamps subsequent to November of this year if the Supreme Court should reverse the law of the lower courts, and thus prolong the life of the Edison patent to January, 1897? Strictly speaking, all such manufacturers would be infringers subject to an accounting for past profits and subject to an injunction restraining them from continuing the manufacture of lamps. For the decision of the Supreme Court would be in effect that the Edison patent had continued to live, the lower courts having been in error in limiting its life to that of a foreign patent granted prior to the grant (not application) of the domestic one. It does not follow, however, that the courts would treat cases under these circumstances as it would infringers at the present time. Notwithstanding that the owners of the Edison patent might claim that their patent was still in force after November, 1894, and give notice to that effect to those starting after that date to manufacture incandescent lamps, the latter would have a strong plea of good faith through the unanimous decision of the lower courts in favor of the view which implied the expiration of the domestic Edison patent with the Canadian one. As a consequence of the equities in their favor, and particularly in respect to companies started after November, 1894, it is probable that the courts would not in any case sustain claims against them that were not entirely reasonable under the extenuating circumstances, so there is no reason to fear a repetition of the harsh measures heretofore enforced against infringers. It may be said that such a course would be a hardship against the owners of the Edison patent, as it is through no fault of theirs that the ambiguity in regard to its expiration exists and that when the Supreme Court sustains their claim the courts should enforce it rigorously. Such a view would, if established, however, place in the hands of powerful corporations a dangerout weapon, of which they could take advantage to frighten away competition even after having been defeated on the main points at issue by continuing litigation and claiming to expect a reversal, accompanied by the threat that they would then crush those who had taken advantage of the original decision. As there is said to be an exceedingly small chance of a reversal in the Bate refrigerator case, and as a decision is expected before November, there is really little occasion for speculation as to what might happen in the contrary case.

ELECTRIC CONDUIT ROADS.

As is well known to our readers, the city of Budapest is provided with a conduit road which has now been in succussful operation for a number of years. As this road is by far the largest and most successful of its kind and as it may now be considered to be running normally, we give in another column an abstract of the report for the year 1893, which will doubtless interest those who are giving attention to conduit roads. From this report it will be seen that the road is paying a dividend and is being extended, overhead lines being added for suburban traffic, in which they are replacing steam lines. Like in all new undertakings, the cost is undoubtedly greater than it would be in a similar line constructed at the present time, with the knowledge gained from the experience with this road. In this connection we might call attention to the fact that in view of the frequent inquiries about the effects of snow, rain and ice on this line, we made personal inquiry a few years ago, the results of which were very favorable. Our special correspondent at Budapest recently informed us that in the past winter there was one very severe snowstorm, during which the road was stopped until nearly noon; the storm was an unusually severe one, and also stopped the traffic on all the horse car lines, as well as on steam railroads. If this is the worst that can be said against the conduit road, it certainly is not very bad. From this article and others that have heretofore appeared in our columns, it appears that the success, both technical and financial, of this system has been thoroughly established, and there need, therefore, be no apprehension of failure in New York, where it is proposed to soon commence the construction of three miles of road practically the same as that at Budapest. In our issue of May 12 we referred to the official announcement of the Metropolitan Traction Company, of New York City, that it had decided to give the Budapest system a trial and that the Siemens-Halske company, which had built the European road, would also build the proposed one in New York. From an official statement issued on last Saturday, however, it seems that the Tammanyesque Traction Company has changed its mind in regard to giving the contract to this firm, its latest announcement being that the General Electric Company will build the road. President Vreeland states that three miles of road will be built over a route not yet selected, using a voltage of 300. The Metropolitan Traction Company will construct the roadbed and conduit precisely in the same manner as if a cable were to be used, and supply the cars with steam power for the operation of the road, while the General Electric Company will supply and install a complete electrical outfit. When completed the road will be operated for a year by the Traction company, at the end of which time, if the experiment has been successful, the General Electric Company will be paid the sum previously agreed upon, and the system extended to other lines. If unsuccessful the electrical equipment must be removed and the road will then be equipped with a cable. It is intimated that patent litigation will result from this latest move, the Siemens-Halske company claiming that its patents will be infringed by the General Electric Company if it constructs the road provided for in the contract, while the latter reports that its patents would have been infringed by the former if the contract had been awarded to it. While stockholders concerned will not view with equanimity this further prospect of patent litigation, the electrical street railway industry will receive another impetus if the conduit experiment is successful, of which there seems to be little reason to doubt.

The Invention of the Telegraph.

To the Editor of The Electrical World.

Your issue for June 2 contained an article apropos of this being the semi-centennial anniversary year of the opening of the first telegraph line, and you therein erroneously state that the "first public message" was sent upon the 24th of May, 1844, and that it was the message: "What hath God wrought?"

Permit me to correct this mistake, which I am not surprised at your making, for the date mentioned has always been considered that upon which the first message was sent. It was upon that date that the first message of which there is any record was sent over the completed line between Washington and Baltimore, but as a matter of fact it was neither a public nor a news message, for it was absolutely a private one, sent by Morse (at Washington, and received by my father, Alfred Vail, at Baltimore), in fulfilment by him of a promise made by him to Miss Ellsworth, daughter of the then Commissioner of Patents. This lady was much interested in the efforts to obtain the passage of an act by Congress appropriating $30,000 to build the line from Washington to Baltimore, and was the one to carry to Morse the news of the final passage of the bill, whereupon he promised that she should dictate the first message to be sent over the line when completed.

The really first public and first news message that was ever sent by telegraph was sent on the afternoon of the 1st of May, 1844 (twenty-four days in advance of the so-called first message), and was sent from Annapolis Junction, upon the Baltimore and Ohio Railroad, 22 miles from Washington, which was upon that date the end of the line, then being built.

My father obtained from passengers upon the afternoon train from Baltimore to Washington upon that 1st of May the information that the Whig convention, assembled to nominate candidates for the Presidency and Vice Presidency, had met, nominated Henry Clay and Frelinghuysen and had adjourned, and that many of the delegates were upon that train, bound for Washington.

My father immediately telegraphed the news to Morse at Washington, and when the train arrived there the passengers were astounded to find a great crowd at the station cheering for Clay and Frelinghuysen, and, too, they saw in the "extras," which the newsboys were crying, the information in print.

This information I have had from one of the delegates to that convention, and I also found it stated in a letter, written the next day by my father to my mother, who was in New York.

I have no desire to detract from the credit due Morse, Henry or any other of the many scientists who have contributed more or less to that which now constitutes the electric telegraph, but I do feel that the very important part taken by Alfred Vail has never, either at the hands of Morse or the world, received the consideration due it.

Prof. Franklin L. Pope has justly said: " * * * The telegraph of to-day, and the universal telegraph of the future, comprises solely the work of Joseph Henry and Alfred Vail. * * * " Surely he who contributed to the invention the dot and dash alphabet and the recording receiver and the finger key, only by which that alphabet could be utilized for the transmission of intelligence, should be accorded the credit for what he has done.

New York City. STEPHEN VAIL.

I do not care to enter into a newspaper controversy with Mr. Vail, which could be productive of no good whatever.

My father's claims were upheld by the Supreme Court of the United States, and during his lifetime he successfully defended his title as the father of the telegraph against countless claimants, who had contributed something or nothing to its success. That Alfred Vail rendered most valuable technical and financial assistance to Prof. Morse, those who know anything about the birth of the telegraph would never dream of denying. That he and Prof. Henry were the "sole" inventors of the telegraph of to-day is a preposterous statement which it is not worth while to notice. Alfred Vail's letters to my father, which are now in our possession, breathe nothing but a spirit of profound respect and gratitude. If in his letters to his family he wrote differently, I can only say that it does not redound greatly to his credit. Alfred Vail was a man of means, and when the dark days of the telegraph came, he was discouraged, and with the other partners, gave it up as a failure. As a parent he deserted his child. Morse, then alone and unaided, almost on the verge of starvation, carried the enterprise through to success. Then, Alfred Vail and the other partners came back and helped to reap the benefits which Morse had secured for them.

In all great enterprises one name is bound to stand preeminent. That Morse frankly availed himself of the services and assistance of others does not in the slightest regree detract from his fame. This was the opinion in the Supreme Court case, and this must be the opinion of posterity. In spite of petty quibbles as to which was the first public message, and who ran to the printer's office to find out which letter of the alphabet occurs most frequently, Morse remains the father of the telegraph. The first simple principles which sprang as if by inspiration into the brain of the poor artist on the packet-ship Sully, in 1832, are the principles of the telegraph of to-day. All the hair-splitting in the world will not alter that fact. It was the verdict of the world during my father's lifetime, it is the verdict among scientists to-day, it will be the verdict of the future to all time.

Bedford, N. Y. EDWARD L. MORSE.

Alternating Currents and Fuse Wires.

BY DUGALD C. JACKSON.

In the editorial comments made in your issue of May 26 on papers read at the last meeting of the American Institute of Electrical Engineers, the correctness of Mr. Ochsner's experiments on commercial fuses is questioned. A conservative position in such matters is certainly to be appreciated in all cases where the results of experiments do not agree with the results of previous experience. In this case the results seem to agree so closely with general experience that the correctness of Mr. Ochsner's conclusions seems to be fully borne out.

In the discussion of the fuse question at the last convention of the National Electric Light Association the eccentricities of fuses were thoroughly ventilated, but it does not appear that fuses are considered less reliable by station men when used on alternating current circuits than when used on continuous current circuits. Oxidation was brought into that discussion as a fertile cause of unreliability in fuses, and there does not seem to be any reason to expect the character of the current to affect the oxidation. Mr. Ochsner's paper was completed before the report of the Washington discussion was published, but the two seem to be in harmony. The same is true of similar discussions which have occurred elsewhere, and the experience of the majority of people whom I have consulted in regard to the matter and experience of my own tend to the same conclusions.

If the resistance of any commercial fuse alloy when used on alternating current circuits is liable to an increase as great as 15 to 30 per cent. in a few hundred hours, accurately rated fuses are a delusion. If a marked effect of this kind is to be found in fuse alloys, it seems entirely reasonable to

expect a commercial depreciation in brass and german silver, and even in copper, iron, etc., when used to conduct alternating currents. That such is not the case is shown by resistance coils, electric light lines and wires in other uses, which ordinarily seem to last as well when carrying alternating currents as when carrying continuous currents.

My attention was specifically called to this matter about a year ago, after the question had been raised, by a fuse wire manufacturer, who wished me to determine whether his wires were appreciably affected by the alternating current. I found that they were not affected within the comparatively limited test period, and Mr. Ochsner then took up the more extended testing of various other wires with the results given in his report. The way in which the work was carried out gives me confidence in the correctness of Mr. Ochsner's conclusion that as far as the direct action of the current is concerned, fuses are just as reliable on alternating as on continuous current circuits. Unstable alloys may doubtless be made whose resistance will be affected in a marked manner when a current is passed through them, but this does not appear to be the condition of the ordinary fuse alloys.

General Electric and Fort Wayne.

The final struggle between the General Electric and the Fort Wayne Electric began with a number of legal skirmishes last week, the result of which would appear to incline in favor of the latter. The immediate cause was a publication of a notice calling for a meeting of the stockholders of the Fort Wayne Electric Company "to elect directors and transact other business." The local Fort Wayne interest assumed that the object in view was to close the Western works and transfer the business to Schenectady. To avert this supposed action, R. T. McDonald, on June 6, applied to Judge Dawson, of Fort Wayne, Ind., for the appointment of receivers to liquidate the affairs of the Fort Wayne Electric Company, which petition was granted, and H. J. Miller, of Fort Wayne, and E. J. Hathorne, of Boston, were made receivers. Simultaneously with the filing of this application, Mr. McDonald organized and incorporated the Fort Wayne Electric Corporation, with a capital stock of $1,500,000, which contracted with the receivers to continue the business of the Fort Wayne Company and secured the approval of Judge Dawson to this arrangement. The first holders of stock in the new incorporation are R. T. McDonald, C. C. Miller, S. C. Lombard, Charles S. Knight and M. C. Gross.

In New York on June 8 the General Electric obtained an attachment from Judge Andrews, of the New York Supreme Court, against the Fort Wayne company for $500,000, money lent to the latter between May 1, 1892, and May 1, 1894, but the property of the Fort Wayne company in New York had already been transferred to the new incorporation. On June 9, Judge Dawson, of Fort Wayne, granted a temporary enjoining and restraining order to prevent the stockholders' meeting above referred to, and to enjoin the attachment of property in other States, which now, it is claimed, legally belongs to the receivers.

An officer of the Fort Wayne company, in answer to a telegram of inquiry from The Electrical World, telegraphs that the attachment was obtained by the General Electric Company to annoy the new Fort Wayne Corporation and discourage competition, and that the Fort Wayne company claims it is not indebted to the General Electric in any sum whatsoever.

The General Electric Company states that it owns a half interest in the Fort Wayne company, and that its action was to protect this interest and assert its rights against the present policy of bitter warfare of the latter company against it. The Fort Wayne interests claim, on the other hand, that the scheme of the General Electric Company was to secure control of the local plant at the annual meeting, close it up, and transfer the manufacturing business to Schenectady, as has been done with other corporations. A local newspaper charges that a gigantic Wall Street combine is at the bottom of the scheme to close up the shops of competing electric companies and concentrate them on their railroad lines under the direct control of the General Electric Company, in order to profit by the shipping business. The assets of the Fort Wayne Electric Company, the paper states, are sufficient to pay all of its debts and leave a considerable surplus for distribution to its stockholders, so that no man will lose a dollar, and the capital of the new company is ample for its purposes, while the arrangements it has made are such that no sacrifice in respect to the assets in the hands of the liquidators will be necessary.

"Thus, Phoenix-like," it concludes, "rises out of the wreck contemplated by the combine a new company, with a business as broad as the land, to compete with the General Electric octopus and defy its power. Mr. McDonald is doing this for Fort Wayne, for the men who subscribed $25,000 when the integrity of the company was threatened some years ago; he is doing it for the 1,200 employees of the works and their families; he is doing it for his fellow-citizens, for his friends and his home, at a time when he could dispose of his interests at his own price and continue with the General Electric Company at his own salary, with headquarters in New York. A great legal battle is on and in the struggle for the life of the Fort Wayne company Mr. McDonald can rest assured of the sympathy, support and good will of the citizens of Fort Wayne, who are sure to appreciate his loyalty to the metropolis of northern Indiana."

The Field Railway Patent.

To the Editor of The Electrical World.

In Judge Townsend's decision annulling the Field electric railway patent, the main statutory bar to the validity of the patent is held to be an English patent of Clark, granted in 1864. In justice to a meritorious inventor and engineer, still living in Paris, it is proper to remark that the English patent referred to is based upon a French patent of Jean Henri Cazal, dated May 25, 1864, No. 63,155. Clark was merely the agent who obtained the English patent for Cazal, and, in fact, the name of this French inventor appears in the English patent specification as the person who communicated the invention to Clark. An article in "L'Industrie Electrique" of March 10, 1892, quotes the subject matter of Cazal's patent so far as it relates to electric railways and the electrical transmission of power, and an abstract of this article was given in The Electrical World about that time. In the statement of the Field railway case, as it appears in one of the electrical journals, a French patent of "Bovee" is refererd to as another reference for the Field patent. A French patent of F. A. Boue, dated Sept. 17, 1878, No. 126,446, is undoubtedly the patent referred to. It is reproduced in extenso in "L'Industrie Electrique" of March 25, 1894.

Yours very truly,

Paris, France. A. M. TANNER.

Minimum Temperature of Visibility.

According to a Physical Society paper by Mr. Gray, this temperature for the surface of the solid is about 470 degrees C., but this may be reduced considerably if the person remains for a few minutes in a dark room. At night a surface for 410 degrees C. is visible; by resting the eyes in complete darkness this may be reduced to 370 degrees nearly; different people's eyes differ somewhat, but probably not to any great extent if tested under the same conditions; the surfaces at these temperatures do not appear red, but look like a whitish mist.

SWITZERLAND AS THE PRESENT ELECTRICAL CENTRE OF EUROPE

BY FREDERICK BATHURST.

THE POWER TRANSMISSION PLANT FOR THE OERLIKON ELECTRICAL WORKS.

Before referring in detail to the installation of this unique and interesting plant, which may be taken as an index of the developments we shall ultimately see in all important manufacturing centres, it may be possible in a few words to show that it is but the forerunner of an immense development in Switzerland itself.

Something like one-eighteenth part of the area of this wondrous bit of mosaic, of grass, granite and glacier, is covered with perpetual snow; the glaciers, in fact, reach a total of about four hundred. It is small wonder, then, that the melting of this ice has made it possible to utilize from this natural water source the greater part of 500,000 h. p.

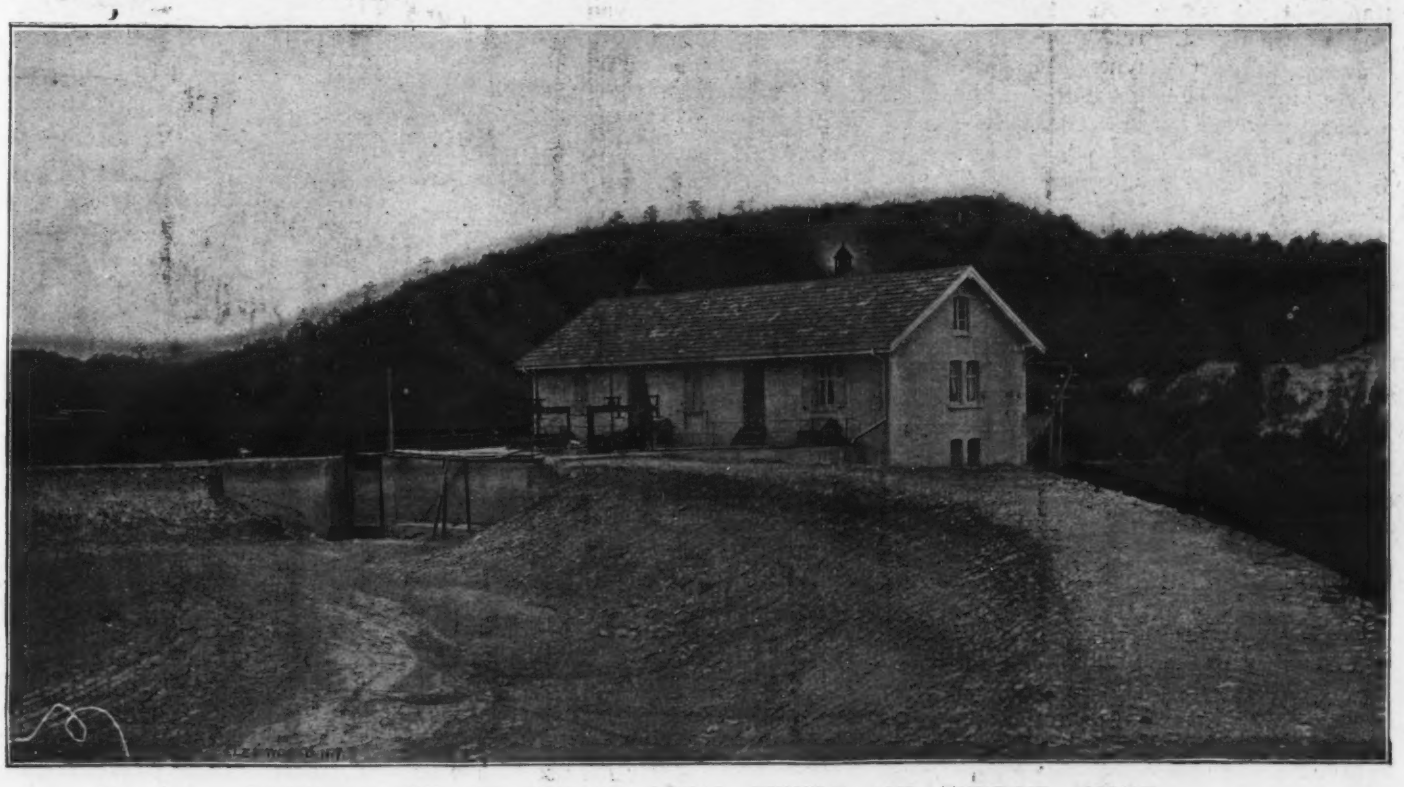
The necessity of power to the Swiss manufacturer is impressed upon the traveller when, in climbing amongst the lower ranges of the mountains, he comes upon some of the many still existing wire rope transmissions and finds that their erection dates from perhaps 20 years back. One of the most indicative of these is that near Wald, by which some 60 h. p. is transmitted over the crest of the hill into an adjoining valley, where the industry is located. In all, a distance of 3,000 metres, nearly two miles, is traversed in the effort to supply power from the convenient generating to the suitable distributing point.

Political as well as physical reasons prevent any extension in the use of coal, which, when obtained under the present conditions, comes either from Belgium or from England, and costs the consumer, when delivered, on the average 26 francs, or $5 per ton.

An interesting problem in this respect is presented to the sociologist and politician. What are the essential causes that govern the suggestion and organization of such huge power transmission schemes as those now contemplated in Switzerland? For instance, the project which originates in Zurich to utilize 12,000 h. p. from the Swiss Niagara, the Falls of Schaffhausen, where the River Rhine with a width of 300 feet takes a plunge of 80 feet, and that originating in Basle to develop 16,000 h. p. from its neighboring water-powers. The former is still further enigmatical when one considers that the town of Zurich does not employ more than 6,000 h. p. in its factories.

There must be some impelling motives behind these schemes, but whether they materialize or not it is evident that the Swiss themselves fully recognize that it is only by the use of electricity that these problems can be solved, and the rest of Europe looks to them as a nation possessing the men best fitted by their dual experience in hydraulics and electrics to carry them out.

The Maschinenfabrik Oerlikon, better known to electricians as the Oerlikon Electrical Works, is no exception to the conditions generally prevailing, and obtain the power they require for manufacturing from a point situated among the hills and dales, 12 miles away from the factory. The visitor or workman must take train northward from Zurich to Bulach, and then walk for three-quarters of an hour through the woods or along a canal to Hochfelden, near



BASIN AT END OF ONE OF CANAL LEVELS AND TURBINE HOUSE.

where the generating station is placed. En route one notices the sight, familiar in Switzerland, of a *dry river;* the course of the bed, where water should be, is marked by large boulders and loose stones, but near it upon the hillside, taking a parallel course down the valley, is a canal, the product of Swiss industry, and which by means of a dam diverts and conveys the river water to a point where it is desirable to pass the water back to its proper course through the turbines of a power generating station. This River Glatt is notably one that with more reason could be called a canal. The dam and embankment work is carried out by a construction company as a private enterprise, for the right and privilege of making a certain charge per horse power for water delivered. The Glatt ultimately flows into the Rhine near Schaffhausen.

The cut shows the basin, at the end of one of the canal levels (then empty), upon which the turbine house is situated. This station is a three-story brick structure built on the valley side of the canal embankment.

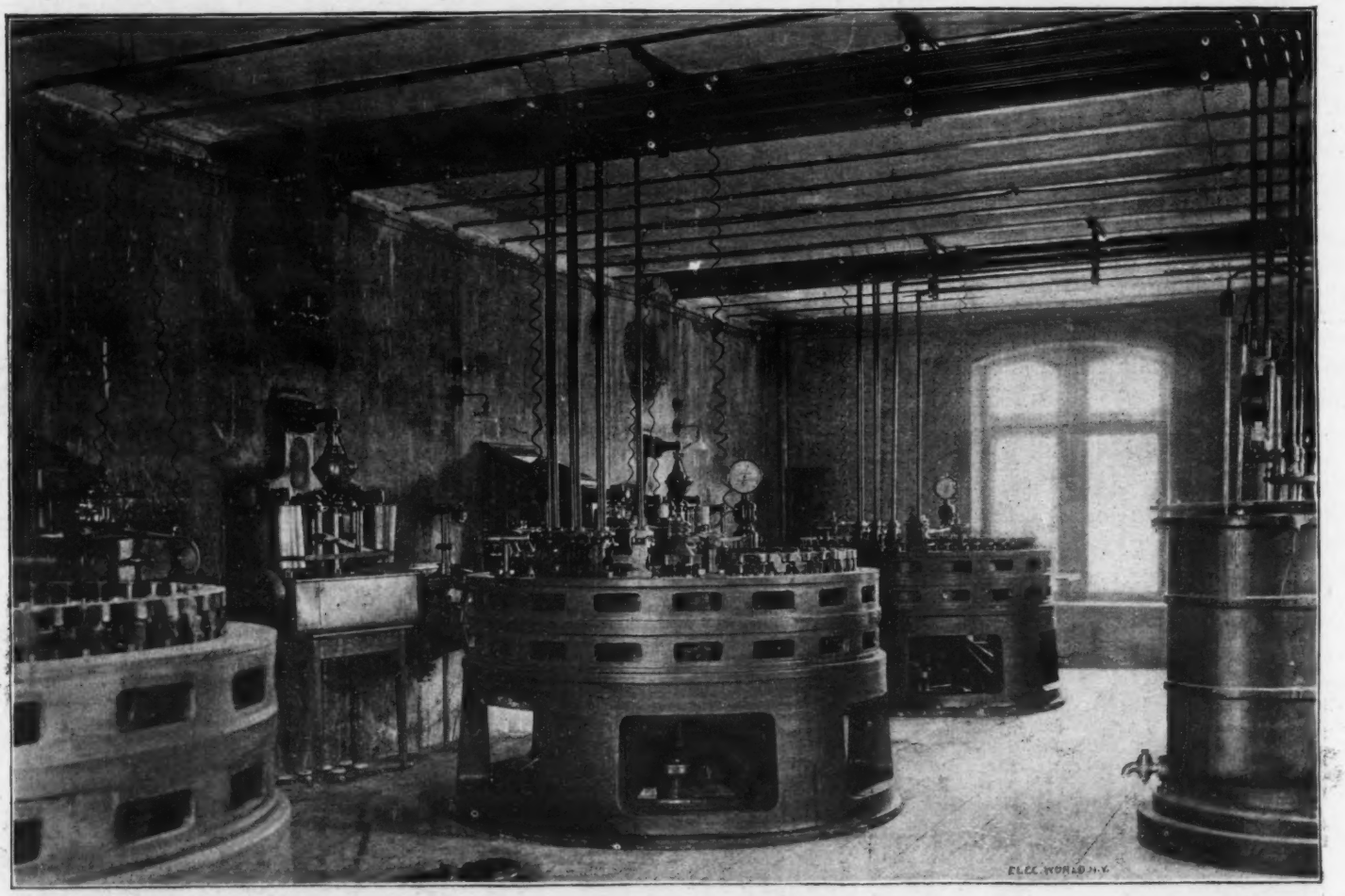
The turbines are placed upon the foundations in the lowest or first floor, having a water entrance from the embankment side.

The entrance to the flumes is regulated by means of the usual form of lift-up gate. A by-pass sluice is provided so that excess water can be conveniently handled. The turbine wheels are arranged horizontally and the shafts pass vertically upward into the second floor.

The Swiss practice is to arrange the wheels of turbines (usually slow speed) driven from low falls horizontally. Those running from high falls are generally quick running and have their driving shafts horizontal.

Above is shown the second floor of the power house, which forms the generator room. The field magnets, 32 poles, separately excited from auxiliary continuous current machines, are placed upon the ends of the vertical turbine shafts and revolve within the armature ring frame, which is raised above the floor level by means of supporting collars. The armature is very simple and substantial in construction, consisting of a laminated iron core ring having 96 holes pierced close to the inner periphery and through which the copper bars are passed. The bars are arranged in three independent circuits. There are three generators and three converters, but only two of each are employed in the regular working, the others being held in reserve. The turbine shafts run at 180 revolutions per minute. Within the armature bars a low-pressure, three-phased, 85 volt current is generated which is passed into the primary coils of the converters, one of which will be noticed standing opposite each machine. A frequency of 48 is employed. The secondary windings of the converters transform up the voltage to 13,000 volts.

The converters are interesting from the fact of their having an oil circulation. Taking the average load on each transformer as 170 kw. and allowing a loss in conversion of 2 per cent., some 3.4 kw. of energy is being lost continuously, which appears as heat. In order to dissipate this heat and maintain the converters at a reasonable temperature, the oil is circulated through serpentine tubes that are immersed in a tank through which there is a constant flow of cold water. The circulation is effected by means of a pump, but the fact is sometimes apparent to the attendant that oil, although a good electrical insulator, is also a good heat conserver.



GENERATOR ROOM.

By the use of low tension generators and converters, the attendant can work around the machinery without fear and danger, and when entering this power house, except for a conspicuous wire netting to be seen on the outside of the building, no one would suppose that it contained anything more dangerous than the ordinary lighting plant. The high potential parts, all being stationary and needing no attention, can be adequately protected.

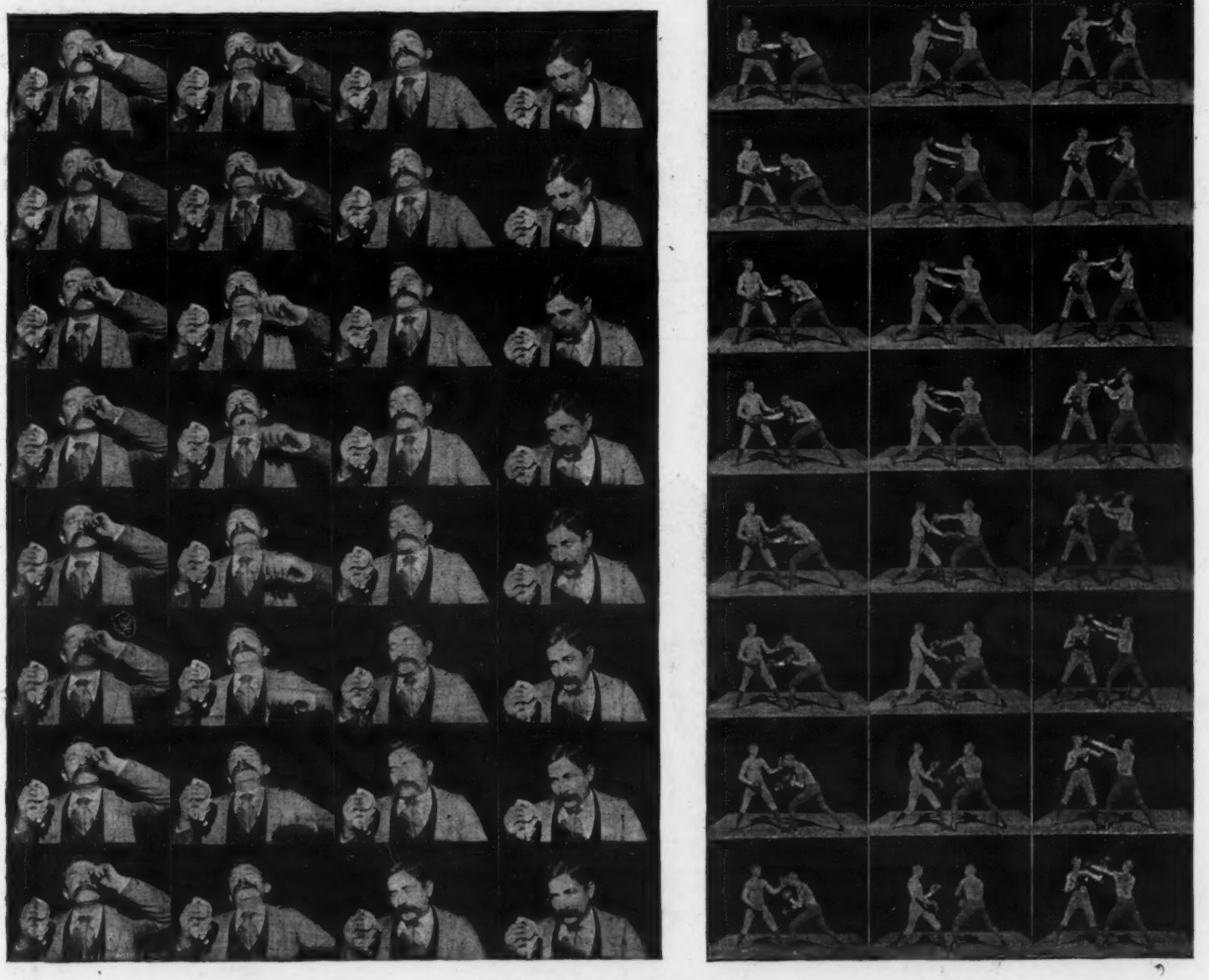
(To be continued.

The Kineto-Phonograph.

Thomas A. Edison conceived the idea of the simultaneous record and reproduction of sound and motion in 1887, the idea naturally being suggested by that familiar toy, the zoetrope. The work of the inventor and his assistants has borne fruit in the kinetograph and kinetoscope, which are now making claims upon public attention, and which, whatever may prove to be their practical value, will stand as striking illustrations of human ingenuity and patience. That Mr. Edison himself believes in the future possibilities of this device is evidenced by the following recently published statement: "I believe that in coming years, by my own work and that of Dickson, Muybridge, Marie and others who will doubtless enter the field, that grand opera can be given at the Metropolitan Opera House at New York without any material change from the original, and with artists and musicians long since dead."

The principle of the kinetograph—the recording—and the kinetoscope—the reproducing—instrument is doubtless generally understood. A series of photographs of the object or objects which it is desired to reproduce are taken with a rapidity of between forty and fifty views per second. These photographs are then developed and by means of the kinetoscope are either projected upon a screen or exposed directly to the eye at the same rate of motion. As the interval between the exposure of the successive photographs is too short to be appreciated by the human eye, the motions of the subject appear continuous to the observer. It is apparent that this invention lies largely in the realm of photography and, as in the phonograph, electricity plays a subsidiary part.

The kinetograph reaches its highest sphere of usefulness in conjunction with the phonograph, by which it is intended to reproduce every word and movement of the subject in their proper relation. For the combined instrument, the name "kineto-phonograph" has appropriately been suggested. While the kineto-phonograph has not been brought to a sufficiently practical form for public exhibition, as has the kinetoscope, the experiments in the inventor's laboratory have been so successful that it is regarded only as a question of time, by those engaged in the work, when the apparatus will be perfected.



KINETOSCOPIC RECORDS.

The credit for the development of the kinetograph and kinetoscope belongs, after the inventor himself, to Mr. W. K. L. Dickson, whose wide experience in photography and familiarity with the application of electricity have rendered

him an invaluable assistant to Mr. Edison. In the June number of the "Century," Antonia and W. K. L. Dickson trace the history and development of the invention and point

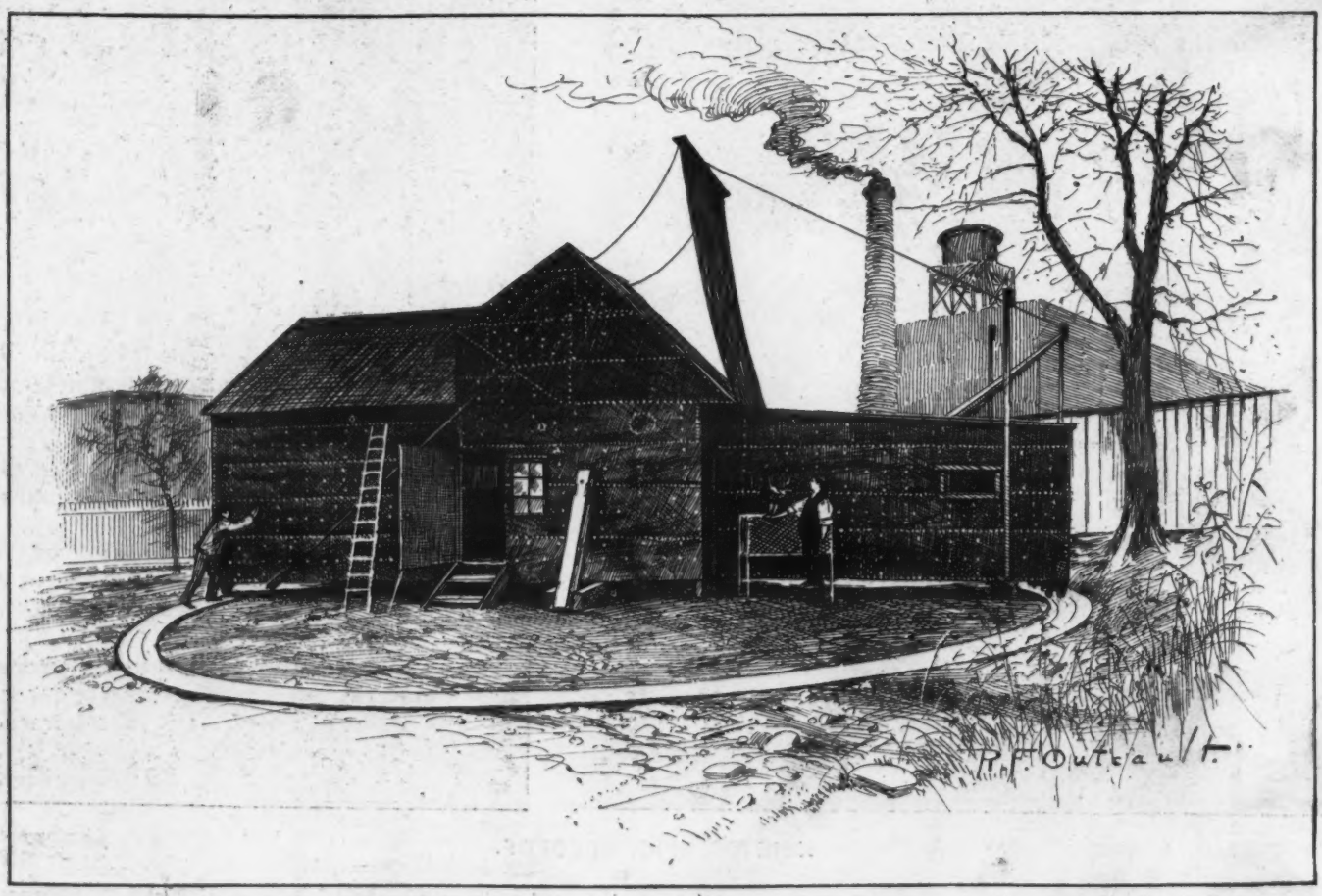
THE KINETOSCOPE ON EXHIBITION.

out some of the many difficulties which beset the path of the experimenter along these lines.

The first experiments were made with a cylindrical shell, the same size as the ordinary phonograph cylinder, upon which minute photographs were placed. The two cylinders were placed on a shaft side by side, and the photographic and phonographic impressions taken as nearly at the same time as possible. Photography at such a high rate of speed was a new art and the first results were not especially promising. The Daguerre, albumen and other similar known processes failed, and an attempt was made to use cylinders coated with the Maddox gelatine bromide of silver emulsion, but the difficulty here was that when the minute photographs were enlarged they were unduly coarse.

The next move was to try larger impressions, which were swiftly rotated upon the edge of a wheel or disc, supplied with a number of pins, which projected under the centre of each picture. These pins successively broke the primary circuit of an induction coil, to the secondary of which was connected a Geissler tube. The tube was lighted at the exact moment the picture passed before it. The results were very encouraging. Experiments were then made with celluloid films placed on drums something like the old tinfoil phonograph. The pictures were taken spirally, the sheet of celluloid removed and developed and then placed on a hollow drum, inside of which was a Geissler tube connected to an induction coil. Brass pins on the exterior of the cylinder broke the circuit at the proper moment and each picture was in turn illuminated. A highly sensitized strip of celluloid half an inch wide was then tried, but the width was soon increased to an inch and a half. The photographs were but an inch in width, but the extra width was perforated and a locking device employed to hold the film steady during the infinitesimal time—about the one-fiftieth part of a second—during which the shutter opened and a photograph was taken. Then in about 1-460th part of a second the film is jerked forward and again held at rest and another photograph taken. This system allows an exposure of one-hundredth part of a second for each picture, which is sufficient for excellent work.

The speed of this photographic work is certainly astonishing. Forty-six impressions are taken each second, which is 2,760 a minute and 165,600 an hour; or, as Mr. Dickson has graphically put it, "were the spasmodic motions added up by themselves, exclusive of arrest, on the same principle that a



EDISON'S KINETOGRAPHIC THEATRE.

train record is computed independent of stoppages, the incredible speed of twenty-six miles an hour would be shown."

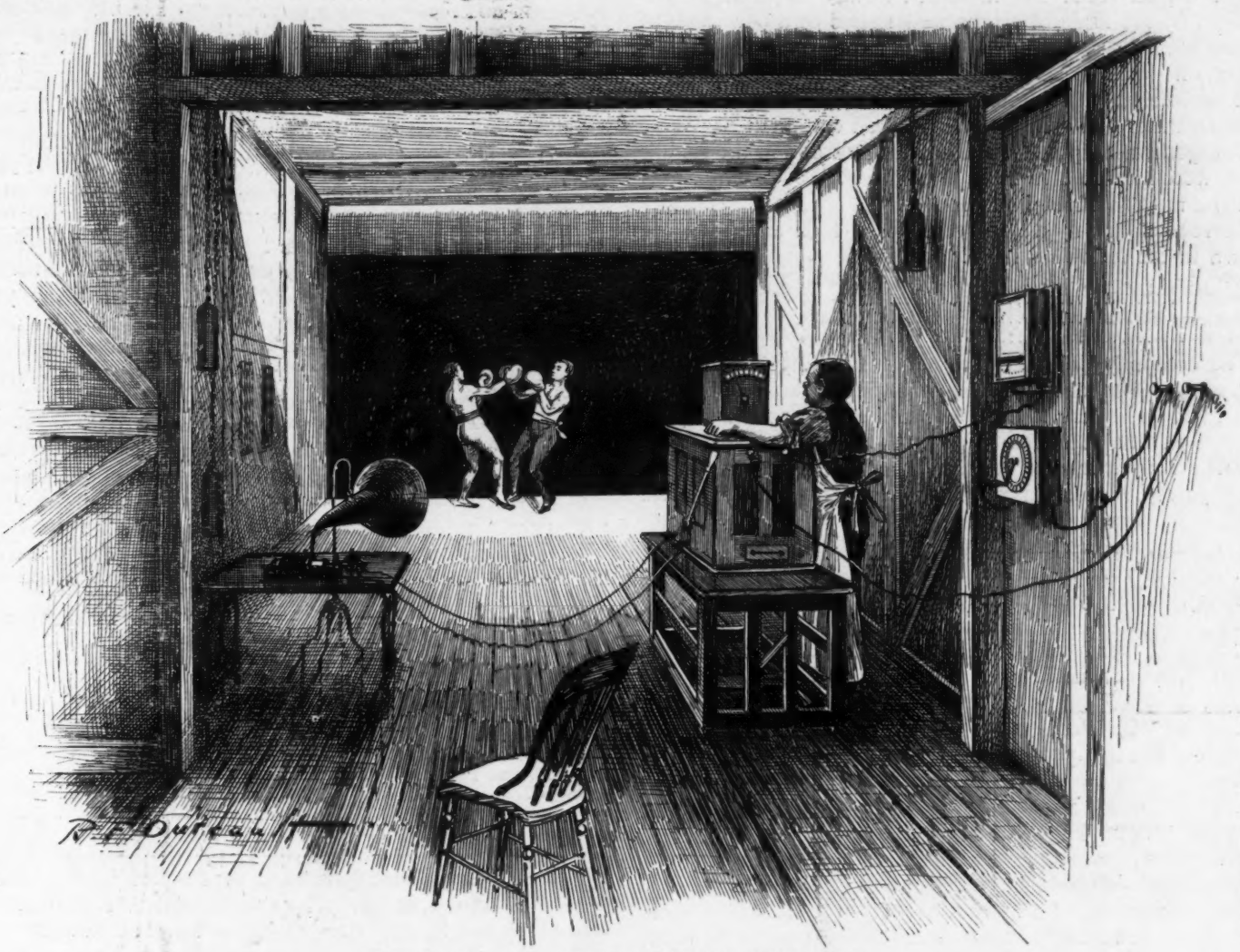
After securing the negative, the next step is to secure a positive strip of film. When this is prepared it is ready to be placed in the kinetoscope or photo-kinetoscope. When a phonographic record has been taken simultaneously with such a strip, the two are started together by a simple device and kept together throughout the reproduction, a single electric motor operating both. One of the greatest difficulties met with by the experimenters was the nicety of adjustment required to simultaneously record and reproduce the sound and motion.

In taking the photographs, either sunlight or artificial light is employed; in the latter case four parabolic magnesium lamps or twenty arc lamps, provided with highly actinic carbons, supplied with powerful reflectors, are used. A special building has been constructed for photographic purposes, interior and exterior views of which are herewith given. It swings on a central pivot, so as to obtain any desired light. A stage is arranged inside and provision made for very sharp contrasts of light and shade.

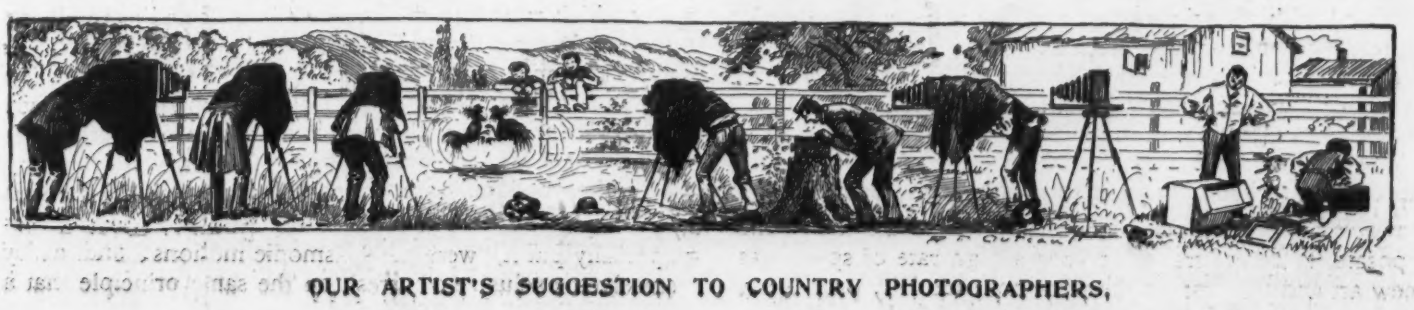
The only form of this apparatus yet placed on public exhibition is a nickel-in-the-slot form of the kinetoscope. Several of these machines may be seen in one of the accompanying views, which shows the interior of an exhibition room on Broadway, New York City. They consist of a cabinet containing an electric motor and accumulator cells for operating the mechanism which moves the film. The film is in the form of an endless band, fifty feet in length, which is passed through the field of a perpendicular magnifying glass. The impressions pass before the eye at the rate of forty-six per second by means of a rotating slotted disc, the slot of which exposes a picture at each revolution and separates the fractional gradations of pose.

Portions of two different kinetoscopic bands are here reproduced showing several sections of the films. Close examination will show the almost imperceptible change between one view and the next.

As to the future of this most ingenious and interesting bit of mechanism, time only will demonstrate whether it is to be a mere scientific toy or an invention of real practical value.



INTERIOR OF KINETOGRAPHIC THEATRE.



OUR ARTIST'S SUGGESTION TO COUNTRY PHOTOGRAPHERS.

Budapest Electric Conduit Railway.

As this road, the largest, oldest and most interesting of the few successful conduit roads, is attracting so much attention, both here and abroad, the following data, taken from the official report of 1893, may be of interest:

The capital stock was increased from $1,446,000 to $1,928,000 by the issue of 10,000 new shares of a par value of $48.20 each.

Certain lines were lengthened, and, furthermore, the "Central-Friedhof" section had its motive power changed from steam to electricity, with overhead conductors.

The generating plant in the central station and the rolling stock were increased to keep pace with the above extensions and the rapidly increasing business.

Corresponding figures for the years 1892 and 1893 are shown in the following table:

	1892.	1893.
Car-miles	1,433,540	1,593,530
Passengers carried	10,989,172	12,499,274
Receipts	$369,558	$443,090

The company has a central station building covering an area of 852.56 square metres, standing in grounds having an area of 2,230 square metres, and two car yards. The yard "Arena ut" has an area of 9,094 square metres, of which 3,221.44 square metres are under cover; the area of the other yard, "Koebanya ut," is 10,660 square metres, with 1,668.17 square metres under cover.

The length of line is as follows:

1. Surface road with underground conductors: Length of street, 12,283.87 metres; total length of track, 25,459.64 metres.

2. Surface road with overhead conductors: Length of street, 5,240.12 metres; total length of track, 10,132.49 metres.

3. Road with steam as motive power and Vignol rails: Length of street, 5,549 metres; total length of track, 6,693.05 metres.

4. The Koebanya car yard, with Haarmann track and Vignol rails: Total length of track, 1,229.69 metres.

Altogether, the length of street is 23,072.99 metres (14.31 miles); length of track, 43,514.87 metres (26.98 miles).

The equipment of the central station consists of three compound condensing steam engines of 100 h. p. each; three dynamos (type J_{91}); three reserve armatures; four compound condensing engines of 200 h. p. each, directly connected with four dynamos (type J_{93}); two reserve armatures for the above; one motor for driving the ventilating fan of the cooling tower and the centrifugal pumps; one continuous current transformer, consisting of two dynamos (E_{20}), for lighting purposes; five Steinmueller water tube boilers of 98 square metres heating surface each; one Steinmueller water tube boiler of 212 square metres heating surface; four Worthington steam pumps, used as cold water and feed water pumps; two centrifugal pumps; two injectors; one cooling tower for thoroughly cooling the water from the condenser; one water filtering apparatus; one washing machine, driven by electricity; one accumulator battery, for lighting the central station and the car yards after the machines have shut down; two traveling cranes in the power house; one bridge scale.

The two car yards, where there are also repair shops, are provided with electric motors and the necessary tools, machines, accumulator batteries, etc.

In order to keep the track clean and in repair, there are sweeping machines, snow plows, etc., which can be driven by horses or electric power.

The rolling stock consists of 92 cars, of which 82 are motor cars, 10 being summer cars without motors.

For the steam railway there are five locomotives, nine passenger cars, and three open freight cars.

The working pressure on the line is 300 volts. The cars are lighted by three incandescent lamps in series.

The operating receipts and expenditures were as follows:

OPERATING RECEIPTS.	
Passenger traffic	$443,090
Various receipts	27,323
Total	$470,413
OPERATING EXPENSES.	
General management	$23,280
Inspection and repair of track	27,330
Managing and commercial service	41,024
Operating and shop service	111,911
Sundry expenses	3,374
Total	212,919
EXTRA EXPENSES.	
Taxes, stamps, etc.	$47,350
Charged off to depreciation	28,920
Stocks redeemed	8,098
Total expenditure	297,287
Balance	$173,126

For the benefit of those who are interested in commercial figures, we give herewith the balance sheet for the year 1893:

BALANCE SHEET.

Assets.	
Track system, central station and rolling stock	$1,643,622
New buildings and improvements	458,809
Bonds deposited at the capital (city)	24,456
Extraordinary reserve:	
Real estate	96,992
Stocks	186,187
Bills receivable	207,905
Cash on hand	7,860
Material in stock	24,115
Total	$2,649,946
Liabilities.	
Capital stock	$1,928,000
Extraordinary reserve	354,033
Traffic reserve fund	3,352
Tax reserve	1,338
Renewal reserve	53,447
Stock sinking fund	8,098
Bonds	7,690
Bills payable	105,842
Coupons not redeemed	442
Balance of 1892	14,578
Surplus for 1893	173,126
Total	$2,649,946

After making deductions from the surplus in accordance with the statutes, it was proposed to declare a dividend of 8 per cent. and to carry $12,315 forward to the new account.

A very brief description of the system may prove of interest in this connection. The conduit is placed under one rail and consists of castings having flanges of 18 centimetres (7 inches), placed 1.2 metres (about four feet), the space between being a conduit of concrete. The oval-shaped conduit has a width of 28 centimetres (11 inches), and a height of 33 centimetres (13 inches). The slot consists of two beam rails having no inside lower flange and fastened to the iron frames by wrought iron angle pieces. The width of the slot is 33 millimetres (one and five-sixteenths inches). The total depth of the foundation below the rail top is 70 centimetres (27 1-2 inches). The conductors, both positive and negative, are made of angle irons, secured by means of insulators fastened to the castings. They are sufficiently high above the floor of the conduit to be protected from the water which may collect. They are, furthermore, under the top of the oval, so that they cannot be touched from the outside. No earth return is used as both leads are insulated. The water which runs into the conduits is collected at the lowest points and passes through settling boxes to the sewers.

The system is run with 300 volts, and all the dynamos lead to common bus wires. The leads are made of lead-covered cables armored with iron bands, and laid directly in the earth; these lead to junction boxes from which others run along the road and are connected at intervals by means of short branch conduits to iron leads in the conduits.

The first portion of the road—about one and a half miles—was opened July 30, 1889, and has therefore been in operation nearly five years.

Practical Notes on Dynamo Calculation.—V.

BY ALFRED E. WIENER.

13.—*Total Length of Armature Conductor.*

The amount of inactive, or "dead," wire required to join the active portions of the armature conductors into continuous turns depends upon the shape of the armature, the height of the winding space, and the manner of winding. In an armature, for instance, having a core section of great length parallel to the pole faces, and but a small thickness perpendicular to the same, this useless addition to the generating wire will be comparatively small, while in short armatures with great core depth the proportion of the dead to the active length will be considerably greater. Furthermore, if two armatures of same length, same core diameter, and same radial depth have equal lengths of active conductor, but are wound with different heights of the winding space—as will be the case if the one has a smooth core with winding covering the entire circumference and the other a toothed body—then the external diameters, and consequently the lengths necessary to join the active conductors, are greater in the latter case, and therefore it is evident that the armature with the higher winding space requires a greater total length of armature conductor. If, finally, two otherwise entirely equivalent armatures are wound by different systems, a considerable difference may be found in the total lengths of wire required to produce equal lengths of active conductor.

a.—Drum Armatures.

The *active* length of the armature conductor being known, the simplest method of expressing its *total* length, for a drum armature, is

$$L_t = k_3 \times L_a, \qquad (19)$$

where L_t = total length of armature conductor, in feet (parallel wires considered as one conductor);

L_a = active length of armature conductor, in feet, from formula (3);

k_3 = constant, depending upon shape of armature and system of winding. See Table XIX.

The ratio, k_3, of the total to the active length of the armature conductor, in a drum armature, depends chiefly upon the ratio of length to diameter of the armature core. In modern machines the lengths of drum armatures usually vary between one and two diameters; in special designs, however, a value as low as 0.75 or as high as 2.5 may be taken for this ratio. The following table gives average values of the constant k_3 for various shape-ratios, for smooth as well as for toothed drum armatures:

TABLE XIX.—RATIO BETWEEN TOTAL AND ACTIVE LENGTH OF WIRE ON DRUM ARMATURES.

Ratio of Length to Diameter of Armature core. $l_a : d_a$	Value of k_3.	
	Smooth Armature.	Toothed Armature.
0·75	2·50	3·10
0·8	2·45	3·05
0·9	2·40	3·00
1	2·35	2·95
1·1	2·30	2·90
1·2	2.25	2·85
1·3	2·20	2·80
1·4	2·15	2·75
1·5	2.10	2·70
1·6	2·05	2·65
1·7	2	2·60
1·8	1·95	2·55
1·9	1·90	2.50
2	1·85	2·45
2·25	1·75	2·35
2·5	1·70	2·25

Another form often used for expressing the total length of wire on a drum armature is indicated by the formula:

$$L_t = K \times (l_a + k_4 \times d_a) = L_a \times (1 + k_4 \times \frac{d_a}{l_a}); \quad (20)$$

K = total number of conductors all around armature circumference;

k_4 = constant, depending upon system of winding.

This formula (20) has the advantage over (19) that no special table is required for its constant, since for a certain type of armature, and a certain system of winding, k_4 is very nearly constant for all sizes and shapes. The value of k_4 for the smooth drum armatures considered in Table XIX. lies between 1.3 and 1.7, and as an average 1.5 may be taken, thus making the formula for the total length of conductor for smooth drum armatures:

$$L_t = L_a \times (1 + 1.5 \times \frac{d_a}{l_a}). \qquad (21)$$

Formula (21), then, means that the additional length of dead wire to every conductor of a smooth drum armature is one and one half times its core diameter, or that the total length of one conductor in a smooth drum is equal to the length of the body plus one and a half times the core diameter. The reason why k_4, even for the same type and same winding method, has not the same value for all sizes, is that the proportion of the core diameter to the thickness of the armature shaft is very much different for different sizes. In a small drum, for instance, the shaft takes up considerably much more room than in a large one, and therefore the dead lengths are comparatively larger in a small machine. In fact, $k_4 = 1.5$ gives too high values for small ratios of length to diameter, which occur in large drums, while the values found by (21) for large ratios of length to diameter, which are met in small armatures, are below those given in Table XIX.

For $l_a : d_a = 1$, or $d_a : l_a = 1$, for instance, we obtain, by comparison of (19) with (20) and (21):

$$k_3 = \frac{L_t}{L_a} = 1 + k_4 \times \frac{d_a}{l_a} = 1 + 1.5 \times 1 = 2.5,$$

while Table XIX., which is averaged from actual practice, gives $k_3 = 2.35$ for this ratio, to which number would correspond the small value of $k_4 = 1.35$.

On the other hand, if $l_a : d_a = 2$, or $d_a : l_a = 0.5$, we get:

$$k_3 = 1 + 1.5 \times 0.5 = 1.75;$$

the table-value for k_3 is 1.85 for this shape-ratio, and therefore the high value of $k_4 = 1.70$ would answer in this case.

For toothed drum armatures the numerical value of k_4, in the practical limits of the ratio of shape, lies between 1.9 and 3, the average being about 2.5; hence formula (20) for toothed drum armatures becomes:

$$L_t = L_a \times (1 + 2.5 \times \frac{d_a}{l_a}); \qquad (22)$$

that is to say, the average length to be added to each active conductor in a toothed drum armature is two and one-half times the core diameter of the drum, or the average dead length in each turn (consisting of two active conductors) is five times the diameter at the bottom of the slots.

b.—Ring Armatures.

In a Gramme wound ring armature of a core section of given dimensions, the ratio of the total to the active length of the conductor depends upon the arrangement of the field magnet frame. There are, altogether, eight different possibilities of arranging the poles around a ring armature; these eight methods, however, can be classified into but five principally different cases, viz.:

Case I. Polepieces facing *one* long armature surface, see Figs. 4 and 5;

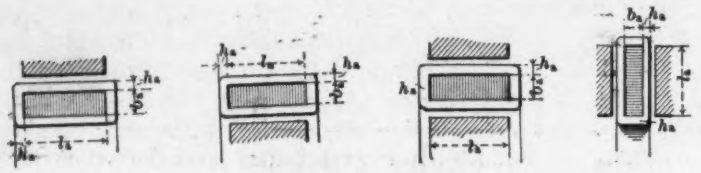
" II. " " *two* long armature surfaces, see Figs. 6 and 7;

" III. " " *one* long and *two* short armature surfaces, see Fig. 8;

Case IV. Polepieces facing *two* long and *one* short armature surface, see Figs. 9 and 10;

" V. " " *one* long, *two* short, and *part* of second long surface, see Fig. 11.

Denoting with l_a the length, and with b_a the breadth of the cross-section, and assuming the winding-height, h_a, to



FIGS. 4, 5, 6 AND 7.

be the same all around the section, we obtain the following formula for calculating the total length of conductor on a ring armature:

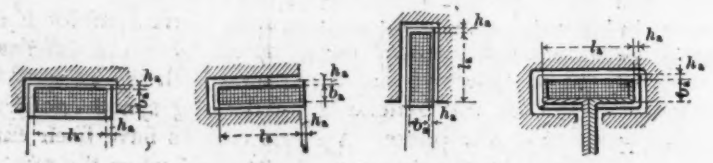
Case I.: $$L_t = \frac{2 \times (l_a + b_a + h_a)}{l_a} \times L_a \qquad (23)$$

" II.: $$L_t = \frac{l_a + b_a + h_a}{l_a} \times L_a \qquad (24)$$

" III.: $$L_t = \frac{2 \times (l_a + b_a + h_a)}{l_a + 2\,b_a + h_a} \times L_a \qquad (25)$$

" IV.: $$L_t = \frac{2 \times (l_a + b_a + h)}{2\,l_a + b_a + h_a} \times L_a \qquad (26)$$

In these formulæ l, b_a and L_a are known by virtue of equations (12), (18) and (3), respectively, and h_a can be



FIGS. 8, 9, 10 AND 11.

taken from Table XV., if the actual winding depth is not already known by having previously determined the winding and its arrangement.

A formula for Case V. is not given, because, in the first place, the arrangement shown in Fig. 11 is not at all practical, and the makers who first introduced the same have long since discarded it, and, second, because the distance of the internal pole projecting depends upon the construction and manner of supporting of the armature core, and, consequently, cannot be definitely expressed.

c.—Drum Wound Ring Armatures.

In modern ring armatures of the types indicated by Figs. 4 and 5, the conductors facing two adjacent poles of opposite

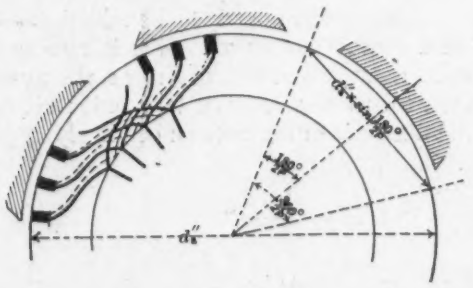


FIG. 12.

polarity are often connected in the fashion of a bipolar drum, by completing their turns across the end surfaces of the armature body, thus converting the multipolar ring armature into the combination of as many bipolar drum armatures as there are pairs of poles in the field frame; see Chapter 25. By this arrangement, which is illustrated in Fig. 12, not only a considerable saving of dead wire is experienced, but also the exchanging of conductors in case of repair is rendered much more convenient, especially when in bending of the connection strips the Eickemeyer method is applied.

The total length of the armature conductor can, in this case, be calculated by applying, for both smooth and toothed bodies, the above formula (21), replacing in the same the core diameter, d_a, by the chordal distance of two neighboring poles, measured from centre to centre along the circumference of the armature over the winding. The formula for the total length of conductor on a drum wound ring armature, therefore, is (see Fig. 12):

$$L_t = \left(1 + 1.5 \times \frac{d_a'' \times \sin \frac{180^\circ}{2P}}{l_a}\right) \times L_a \qquad (27)$$

Inserting in this formula the numerical value for the size of half the pole angle, we obtain the following set of formulae for the various pole numbers that may be used in practice.

TABLE XX.—TOTAL LENGTH OF CONDUCTOR ON DRUM WOUND RING ARMATURES.

Number of Poles. $2P$.	Half Pole-angle. $\frac{180^\circ}{2P}$.	Length of Pole-chord (Diameter=1) $\sin \frac{180^\circ}{2P}$.	Total Length of Armature Conductor (Formula 27) $L_t = \left\{1 + \left(1.5 \times \sin \frac{180}{2P}\right) \times \frac{d_a''}{la}\right\} \times L_a$
			$L_t = \left(1 + 1.161 \times \frac{d_a''}{la}\right) \times L_a$
4	45°	0·707	0·750
6	30	·500	·574
8	22½	·383	·464
10	18	·309	·388
12	15	·259	·333
14	12⅞	·222	·293
16	11¼	·195	·261
18	10	·174	·235
20	9	·156	·196
24	7½	·131	·157
30	6	·105	

(To be continued.)

On the Measurement of the Power of Polyphased Currents—II.*

BY ALEXANDER D. LUNT.

Whatever be the number of conducting wires feeding current to the "mesh," whatever the cross connections between the terminals of those conducting wires, and whatever be the directions of the currents therein, it may likewise be shown that for any given distribution the algebraic sum of the line wire currents is always zero, supposing, of course, that the system is insulated. Each separate current in the "mesh" enters into the equations twice and then with opposite signs. The currents in the line wires, however, appear only once, and hence their algebraic sum is at once shown to be zero by the simple addition of the several equations.

As a matter of fact, the same law of continuity, followed by an incompressible fluid in a system of pipes, is followed by electricity in a system of conductors. Thus, an electric current cannot enter a given space without an equal amount flowing out. And the slightest consideration will show that the same is true whether there be capacity or self-induction in the system.

That the impressed E. M. Fs. may not be zero at any instant is not at all inconsistent with the fact that the line wire currents are algebraically zero at any instant. It is scarcely necessary to add that inequality of the phase angles between and the presence of higher harmonics in the E. M. F. curves only tend toward a reduction of efficiency, and in no way affect the validity of the principle of continuity.

Consider for the moment the meaning of the term potential. Broadly speaking, potential is the capacity of a body for doing work, and is in general a function of the position of the body. If the so-called body be a charge of electricity,

* In Fig. 2 in the section of this article published last week the letters a and b were inadvertently transposed, thus rendering the equation immediately following meaningless. Also the word "not" was omitted after "has" in the first line of the third paragraph of the article.

then its potential is measured by the work required to be done in moving it from a point where its stored-up energy is zero to any given point where the body may be placed. We might consider this transfer of the charge to take place along a conductor. If we imagine a continual succession of such charges being transferred in this manner, we then have an electric current, and the total work done in one second in supplying current at the given potential is represented by the product of the number of unit charges supplied in one second by the given potential.

Thus if q be the quantity of electricity supplied in the time dt and at a potential v, then the product of these two quantities represents the work done or the energy stored up in the time dt, or in other words, $p = q\,v =$ the potential energy developed in the time dt.

Since a given quantity of electricity conveyed in one second represents a certain current, then the rate of doing work, or, in other words, the power of a current at a potential v is $\rho = i\,v$.

Consider any system or network of conductors to which current is supplied from any number of terminals whose potentials are p_1, p_2, p_3, etc. Owing to the differences of potential between the terminals current enters at some and leaves at others. Thus suppose a current i_1 is supplied at one terminal, i_2 at another, etc., then at any instant $\Sigma\, i = 0$ from the principle of continuity. If the current i_1 be supplied at a potential p_1, the current i_2 at a potential p_2, etc., then the total rate of supply of energy to the network is $\Sigma\, i\,p$. Since currents enter at some terminals and leave at others, all in general being at different potentials, it would not be accurate to say that of the total expenditure of energy in the network the current i_1 contributes at the rate $i_1\,p_1$, the current i_2 at the rate $i_2\,p_2$, etc. This would be true only if i_1, i_2, etc., left the network at zero potentials.

For illustration, take a simple case where the network is supplied with current from two terminals. The network may have any form whatever. The current i_1 is supplied at one of the terminals at a potential p_1, the current i_2 is supplied at the other terminal at a potential p_2. The rate of supply of energy to the system is then $\Sigma_2 i\,p$, or,

$$i_1\,p_1 + i_2\,p_2 = i_1\,(p_1 - p_2) \text{ [since } i_1 + i_2 = 0] = i_1\,E,$$

which is the familiar expression for the energy of a linear current. It is evident that the energy supplied at either terminal is not the product of the potential of the terminal by the current supplied at that terminal. The several products represent the potential energies of the several currents, and it is the algebraic sum of these products which gives the energy expended in the network. The separate products, taken by themselves, are indeterminate. In fact, the expression for the energy expended in the network is in some respects analogous to the definite integral of the calculus.

The same reasoning applies whatever be the number of terminals. If the E. M. F. applied at the terminals be alternating or variable, then at any instant the power expended in the network is

$$\rho = \Sigma\, i\,v,$$

where i and v are the instantaneous values of current and potential.

If the network or system of conductors be supplied with current by means of, say, three terminals, then the conditions of either a two or a three phase alternating system are satisfied. The power being expended at any instant in such a system will then be

$$\rho = A\,\alpha + B\,\beta + C\,\gamma, \qquad (1)$$

where A, B and C are the currents supplied at terminals whose respective potentials are α, β and γ as represented in figures (1) and (2).

As previously shown,

$$A + B + C = 0, \qquad (2)$$

whence from (1) and (2),

$$\rho = A\,\alpha + B\,\beta - (A + B)\,\gamma,$$

rearranging,

$$\rho = A\,(\alpha - \gamma) + B\,(\beta - \gamma). \qquad (3)$$

And in the same manner,

$$\rho = B\,(\beta - \alpha) + C\,(\gamma - \alpha), \qquad (4)$$
$$\rho = C\,(\gamma - \beta) + A\,(\alpha - \beta). \qquad (5)$$

These three alternative expressions may be collectively represented by

$$\rho = \Sigma\, i\,(v - v_0);$$

and hence the *mean* power of a polyphased system may be represented by

$$\Sigma \frac{1}{T} \int_0^T i\,(v - v_0)\,dt,$$

where v_0 is the potential of some one selected terminal with which the potentials of the other terminals are compared, and i and v the respective currents and potentials at each of these other terminals.

(To be continued.)

An Optical Phase Indicator and Synchronizer.*

BY GEORGE S. MOLER AND FREDERICK BEDELL.

In starting a synchronous alternating current motor it is usual to bring the motor up to speed by some external means and to switch it into connection with the generator when the motor and generator are running synchronously, but are in opposite phase. Various devices have been employed to indicate synchronism and to show when the motor is in opposite phase to the generator, one of the simplest of these devices consisting of an incandescent lamp used as a pilot lamp. The lamp is connected directly in the circuit supplying the motor, so that all the current through the motor armature passes through it. Before the motor is started the lamp glows steadily. As the motor attains considerable speed, the lamp suddenly flashes up and dies out alternately, according to whether the electromotive force generated by the motor and the electromotive force from the alternator are in the same or in opposite phases. Beats are thus produced which occur at longer intervals as the motor approaches synchronism with the alternator. When the intervals are long enough to be quite marked, the motor is connected directly to the generator circuit by cutting the lamp out at a moment when it is dark, indicating that the machines are in opposite phase. At the same time the external power, which has driven the motor to synchronism, is removed. Instead of one lamp, several lamps or a lamp together with dead resistance may be used where required.

This device is simple and efficient. It does not, however, indicate the moment when exact synchronism is reached, nor does it show whether the motor is running at a greater or less speed than that corresponding to the generator. It does not show the exact phase difference between the motor and generator, and does not indicate the phase relations after the motor has been connected to the alternator and is being driven by it.

The following instrument has been devised by the writers to give definite information in regard to the relative speeds and phase positions of the motor and generator in laboratory investigation. It shows

(1) When the machines are synchronous;

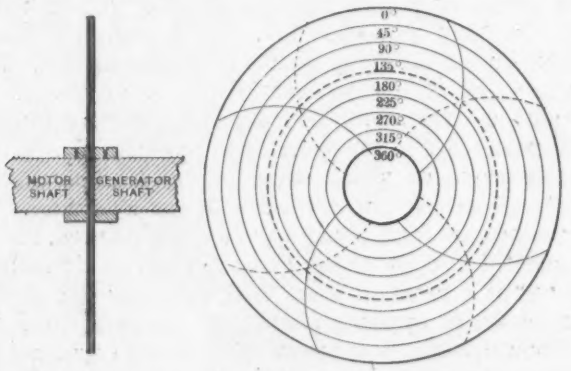
(2) Which machine is running the faster when they are not synchronous;

* Presented at the Philadelphia meeting of the American Institute of Electrical Engineers, May 17, 1894.

(3) The angle by which the motor lags behind the generator.

We will first describe the simplest form of the phase indicator. The motor and generator are placed together with shafts in line and abutting, but not quite touching. The two machines must have the same number of poles, so that a revolution of the armature of each represents the same number of alternations. The abutting ends of the shafts carry two discs, one connected rigidly with the motor armature, the other similarly connected with the armature of the generator, as shown in Fig. 1. In these discs are curved slits, one slit for each pair of poles of the machines. These slits are shown in Fig. 2 for an eight-pole machine. The two discs are in every way similar, the one being the reverse of the other. The two discs are practically superimposed and together form one disc with four holes, where the slits of one disc cross over the slits of the other. Evidently the distances of these four holes from the centre depend upon the relative positions of the two armatures; they move in and out as the armatures shift their relative positions. From the symmetrical arrangement of the slits, if one armature is stationary and the other is moved past two pole pieces or through 90 degrees of arc (corresponding to a complete period of alternation, or 360 degrees of phase), the intersection of the slits will be the same distance from the centre as before. The curvature of the slits is such that the distance to or from the centre that the intersections of the two sets of slits move is proportional to the change in relative position of the two armatures.

When the two armatures are running at the same speed in the same direction and there is a source of light on one side of the discs, the intersection of the slits, as seen from the other side, appears as a continuous ring of light. A slight difference of speed causes this ring of light to move outward or inward, according to which disc is revolving the faster. The more rapidly the ring moves in or out, the greater the difference in speed of the two discs. If the ring is moving out, a new ring starts at the centre when one ring reaches the edges, and these rings keep following one



FIGS. 1 AND 3.

another outward. If the difference in speed is the other way, the successive rings move inward.

In Fig. 3 the heavy dotted line represents the ring of light for a particular position of the two discs.

The position of the ring of light indicates the relative position of the two armatures. The discs may be secured to the shafts, so that when the armatures are in the same positions with reference to the pole pieces (i. e., the machines are in the same phase), the ring of light will be at the inner or outer ends of the slits. The concentric rings in Fig. 3 represent the phase differences corresponding to positions of the ring of light in this case.

For convenience in operation, the arrangement of the apparatus, which has thus far proved satisfactory, has been as follows: On one side of the pair of discs is placed an incandescent lamp enclosed in a box. One side of the box is close to the discs and has a slit in it about half an inch wide, extending from the shaft to the circumference of the disc. This slit is covered with a piece of oiled paper, so as to give a diffused light upon the discs. A complete ring of light is no longer seen from the other side, but only a small portion, corresponding to the width of the half inch slit. A stationary scale is fixed so as to extend from the shaft to the edge of the discs on the opposite side from the lamps, so that the distance of the changing line of light from

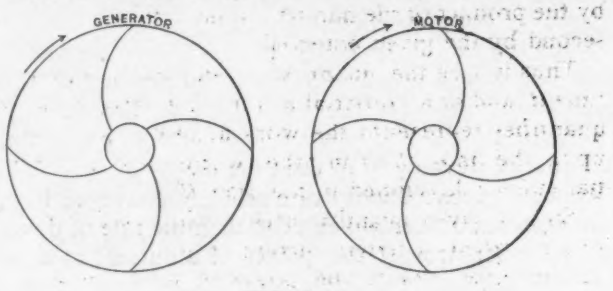


FIG. 2.

the centre may be read so as to give the phase difference of the two machines by direct reading. To enable one to see the scale and line of light most conveniently, a mirror is arranged at 45 degrees with the discs, so that the line of sight is at right angles to the shaft.

The discs may be arranged in the manner just described upon the abutting ends of the motor and generator shafts only in case the two machines have the same number of poles. Where such is not the case, one or both of the discs can be driven by gears, which will give the proper relative speeds of the two discs.

In operation, the instrument has proved quite satisfactory, giving exact and definite information concerning the changes in the armature lag of the motor. The fluctuations in this lag are usually quite marked, and the conditions which cause them can be readily investigated by this apparatus. For instance, this fluctuation is small with proper field excitation; as the field current of the motor is diminished, this fluctuation increases, the line of light moving rapidly back and forth through a greater and greater distance, which finally becomes so great as the excitation is weakened that it goes a distance beyond which it cannot recover; i. e., the motor gets out of step and stops. It would be possible to make a more detailed investigation of these fluctuations by means of a revolving mirror, and they may be photographed and made of permanent record by means of a moving plate.

The apparatus can be applied to other lines of work involving an investigation of phase differences and synchronism, and may be modified to meet the requirements of the problem in hand; but it is peculiarly suited for use in synchronous motor work, for which it was designed. The scope of the present paper admits only of a general description of the apparatus here given.

Standardizing Electrical Measuring Instruments.

BY ELMER G. WILLYOUNG.

In the introduction to his paper the author briefly traced the history and development of electrical measuring instruments, showing that as electrical machinery was improved the necessity of better measuring devices was recognized, and various styles of instruments were originated and brought to varying degrees of perfection. As at present made, however, all of these various instruments have in them dangerous elements of change, and must be frequently examined and restandardized. Consideration of this fact convinces the author that this restandardizing should be done by the stations themselves, and an arrangement of

* Abstract of a paper presented at the Eleventh General Meeting of the American Institute of Electrical Engineers, at Philadelphia.

apparatus should be devised which would make the utilization of some absolute standard method simple and convenient. The potentiometer method seems to be the only one at all satisfying these requirements.

THE POTENTIOMETER METHOD.

Broadly, the potentiometer method consists in opposing some known proportion of the drop of an unknown E. M. F. through a given resistance to a definitely known E. M. F., the proportion being so chosen that no current is produced by the latter known source. This condition being established, an equation involving the unknown E. M. F. as the only unknown quantity immediately obtains. The method in general is fairly well known, being variously called the standard cell method, the Poggendorf, or Rayleigh-Pog-

FIG. 1.

gendorf compensation method, the Rayleigh method, etc.; it is not by any means so widely known, however, as it deserves to be.

The advantages of the potentiometer are: (1.) It is a zero method; a calibrated galvanometer, is, therefore, not necessary. (2.) Accuracy depends only upon a standard cell and a standard resistance, and results obtained by the best authorities over a number of years show that both of these may be relied upon within extremely small limits of error, with proper treatment, for a practically indefinite time. (3) It requires but simple apparatus, always obtainable, and ordinary care. It can be used without inconvenience in re-

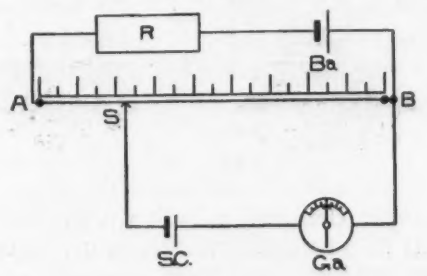


FIG. 2.

gions of great mechanical instability and of intense and variable magnetic fields.

AN IMPROVED DIRECT READING POTENTIOMETER.

This instrument, invented by the writer and illustrated in Fig. 1, is capable of being used for measurements of voltage from 0 up to 1,500 volts and of current from 0 up to any required upper limit with a maximum error of not over 1-10 per cent. It is based upon the form of potentiometer originally suggested by Dr. Fleming, which is shown in diagram in Fig. 2. Some good suggestions were also obtained from the improved form of Mr. Crompton.*

A diagram of the arrangement of circuits in my improved form of apparatus is shown in Fig. 3. The wire B of Fig. 1 is here equivalented by three sets of coils marked respectively Q, M and S. The regulating resistance (R of Fig. 2) is made up of two parts, one resistance, R^q, consisting of coils, and the other, R_q, being made up of a bare wire of resistance equal to one of the coils of R^q. This wire is laid back and forth upon about 350 degrees of an ebonite cylinder and has a fixed brush, P, so

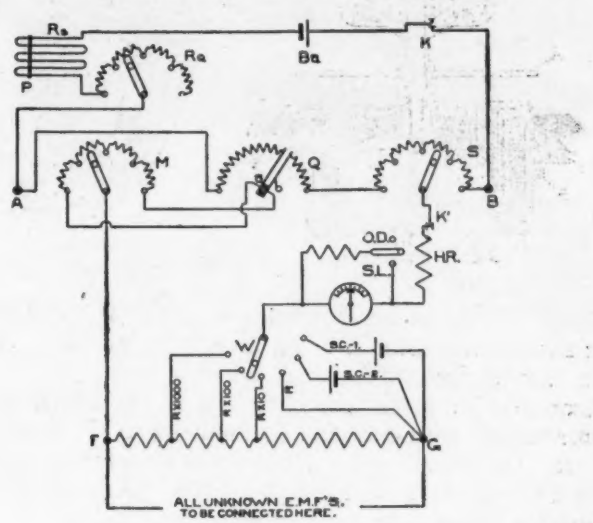


FIG. 3.

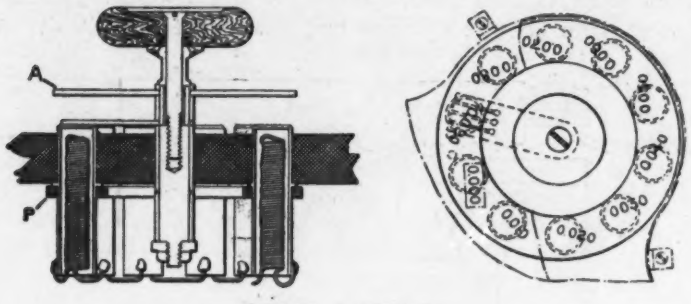
arranged with reference to it that P short circuits more or less all of the v's simultaneously, thus giving a large range of variation for a very small angle of rotation. The quick and rough regulation is effected by R_q, while the finer adjustment is obtained by R^q.** The two series of coils, M and S, have at their centres two switches which are in series with the galvanometer and unknown E. M. F.; moving these switches over the coils is exactly the same as shifting the points S and B of the derived circuit in Fig. 2 M is the medium movement, each coil being 1-140 of the entire resistance between A and B, while S is the very slow movement, each of the nine coils in S being equal to 1-10 of the resistance of one of the coils of M. In order to get a rate of separation of the two derived circuit terminals by steps of 10 times the value of a coil of M, a third series of resistances, Q, is provided. This is a rather peculiarly arranged affair, its function being to take out resistance from between the derived circuit terminals and place it outside, or vice versa, the total resistance between A and B remaining always constant. The construction of this arrangement is shown in Fig. 5; here merely the diagram of circuits can be depicted. It is evident that this change of resistance from one part of the circuit to the other accomplishes exactly the same result as is obtained by M and S, viz., the separation or bringing together of the two derived circuit terminals, We have, therefore, the entire resistance, A, B, divided into 1,500 parts, and the derived circuit terminals separable along this resistance by steps of 100 parts, using Q; 10 parts, using M; and single parts, using S. This means an ability to set to 1 part in 1,500, or to 1-15 per cent.

Some of the details of construction employed in this instrument are, it is believed, sufficiently interesting to be worthy of description. Fig. 4 shows a novel way of econo-

* See "Electrician" (Lond.), May 12, 1893, page 32.

** Instead of this form of regulator I have thought of substituting some form of carbon or graphite resistance, since all that is needed is invariability for a certain period.—E. G. W.

mizing space and material in the construction of the coils and contact points suggested by Mr. H. L. Sayen. The contacts instead of being brass rod or portions of rod, as usual, are tubes having a metal end. Into these tubes the coil, wound on a slim spool as usual, is slipped, one end of the wire being soldered to the open end of the tube. Holes just large enough to receive these tubes are then drilled into the rubber top of the instrument and the tubes slipped up from below with closed ends uppermost until stopped by a



FIGS. 4 AND 6.

flange which has previously been soldered around the tube at about three-fourths of an inch from its end. A rubber plate, *P*, about one-eighth of an inch thick, and also drilled through with holes corresponding to the tubes, is slipped over them from below and screwed fast to the under portion of the top plate. All the tubes are thus firmly clamped in place by means of their flanges. The other ends of each coil are then soldered to the next tube, etc.

Fig. 5 shows the construction of the resistance exchanging arrangement, *M*. There are two concentric circles of segments as pictured, these segments being provided with spring pieces. The coils are joined between diagonal segments. Pivoted at their centre is a switch formed of a circular plate of hard rubber, carrying at its periphery a number of angled brass wedges or knives corresponding to the segments of the coils. Instead of one of these wedges is a pair of contact pieces corresponding to *a* and *b*, of Fig. 3, and joined to the rest of the circuit as shown in that figure; each piece of this pair makes contact with but one segment. It is obvious, therefore, that as the switch rotates the series is always broken between *a* and *b*, while the continuity of all the rest of the series is maintained by the wedges which pass between the segments and keep them metallically joined.

In order to get at the standard cells in case either or both of them should show any signs of giving out, all that is necessary is to remove the four screws in the raised block seen in the upper left-hand corner of Fig. 1. This will expose the binding posts to which the cell terminals are joined, the cells themselves being contained in two brass tubes passing down through the top. The binding screws are loosened and the cell or cells drawn out, when they can be shipped back to the maker for exchange.

This form of potentiometer is practically direct reading, the required values of E. M. F. being numerically set down upon the face of the instrument when balance is attained. The manner in which this is effected is very readily seen from inspection of Fig. 6, which shows a composite view of one of the switch devices *M* or *S*. Fixed to the switch handle so as to rotate with it and above the contact and contactor itself is a disc, *A*, of Fig. 4, of hard rubber; this has engraved upon its upper surface a series of numbers corresponding to the coils of the series, and differing in value by an amount equal to the value of the resistance of each coil in terms of the whole resistance between *A* and *B*. Thus, the disc of *Q* having 14 resistances, each 1-14 of the whole resistance is engraved with the series of numbers 0.100, 0.200, 0.300, etc., up through 1,400. *S*, on the other hand, is engraved 0.001, 0.002, 0.003, etc., through 0.009. *M*, in the same way, has its disc, which is engraved 0.010, 0.020, 0.030, etc. In the instrument these three switch devices are grouped together, as shown in the general view, Fig. 1. A raised metal box, in shape something like a three-leaf clover, covers their operative portions. In each box there is cut a rectangular hole just large enough to expose a single one of the numbers engraved upon the rubber disc below. These numbers are so placed upon the disc that the one visible indicates the number of parts of the whole resistance, which, by virtue of the position of its switch, are placed between the points of the derived circuit. The sum of the three numbers displayed is, therefore, the total number of parts of the whole placed between the derived circuit terminals by virtue of the position of all the switches, the number of tenths being taken from one, of hundredths from another, and of thousandths from the third.

The value of this instrument as a convenient and quick way of obtaining absolutely reliable determinations of current and E. M. F. is, we believe, very great. There are scores of engineers, laboratories and stations who constantly find it necessary to secure a standardization of their ammeters or voltmeters. To make a voltameter determination takes a great deal of time, even if but one value is to be gotten, and an amount of skill and painstaking not always immediately available. The absolutely steady current, suitable solution, chemical balance, etc., are also adjuncts not always at hand. To keep any form of standard instrument about for purposes of comparison is usually not feasible. If the instrument has springs the springs may change. If permanent magnets they are almost bound to change. Other forms of apparatus more free from variable elements, as e. g., tangent galvanometers, are easily affected by strong fields and mechanical disturbances and require either to be always kept set up absolutely undisturbed or else to have considerable time spent upon them each time before using, in order to adjust them into good condition. In the potentiometer there are practi-

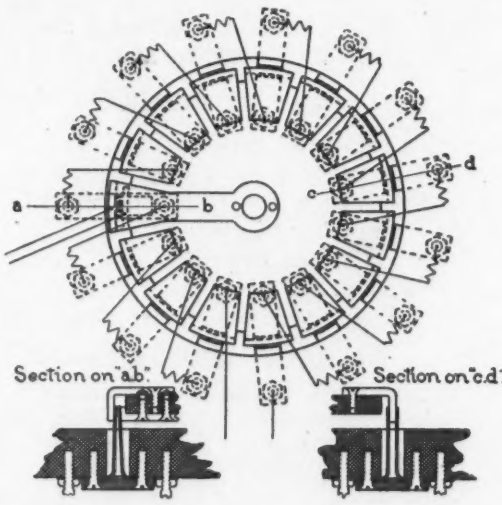


FIG. 5.

cally no variable elements, at least within limits practically infinitesimal in practical measurements. Dependence is placed solely and entirely upon standard resistances and standard cells, both of which have been thoroughly investigated by many workers and the variations of which are well understood. The apparatus is simple and compact and its mode of use can be successfully learned by a schoolboy in a few moments.* Being a zero method it is absolutely unaffected by neighboring currents or magnetic fields and the galvanometer being a dead beat and jewel suspended D'Arsonval, may be used under the most severe conditions of mechanical shock and vibration. On board ship it is believed absolutely the only apparatus which could possibly be used.

* The dimensions over all are 11 inches by 14 inches by 5 inches deep; weight less than 10 pounds.

THE ELECTRICAL WORLD'S DIGEST

OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING.

ELEC. WORLD, N.Y.

ELECTRO-PHYSICS.

Velocity of Propagation.—An Academy paper by Mr. Dufour is abstracted at some length in "L'Ind. Elec.," May 25; the object is to find whether the equality in the velocity of propagation of very short electric waves in space and along conductors exists for waves which are shorter than 30 cm., which is the shortest with which Hertz experimented; it is shown that the law is true to lengths as short as 8.5 cm.

Propagation of Electricity Along Lengthy Conductors.—The Lond. "Elec. Rev.," May 25, gives a brief synopsis of a recent paper by Prof. Potier from the "Jour. Phys. Theor. et Appliquee," 3, page 107, in which he discusses the relative truthfulness of the two theories which are held, without, however, deciding in favor of either.

Magnetic Deflection of Cathode Rays.—The translation of an article by Mr. Lenard from the "Wied. Ann.," 52, No. 5, page 23, is given, together with a number of illustrations in the Lond. "Elec.," May 25.

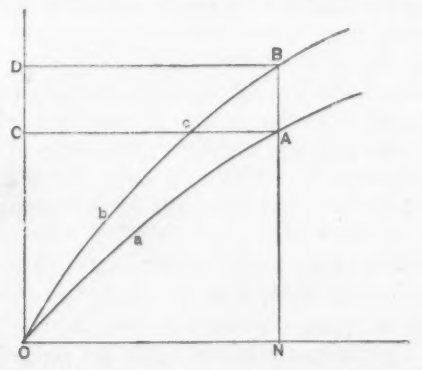
Ether.—In "La Lum. Elec.," May 26, Mr. Blondin gives at some length a resume of the (British) Royal Society paper by Mr. Larmor, published in the "Proceedings" of that Society, volume LIV., page 438.

Optical Wave Surfaces.—A Royal Society paper by Mr. Heaviside "On the Transformation of Optical Wave Surfaces by Homogeneous Strain" is abstracted briefly in the Lond. "Elec.," May 25.

Physical Science.—In the leading editorial in the Lond. "Elec. Rev.," May 25, attention is called to the wise and careful use of the imagination in experimental investigation in physics.

MAGNETISM.

Force Exerted by an Electro-Magnet.—In a brief paper by Mr. John Hopkinson, published in the Lond. "Elec.," May 25, he discusses the subject in the following way: Referring



FORCE EXERTED BY ELECTROMAGNET.

to the adjoining figure, in which *OA* is the curve in which the ordinates are induction and the abscissae magnetizing forces, the work done in magnetizing the field of the magnet is the area, *OaAc*, divided by 4π if *OA* represents this curve when the armature is in one position and *OB* that after the armature is moved to a closer position, then he shows that the net work done by the current is represented by the area *OaABbO*, divided by 4π, and this is equal to the mechanical work done upon the armature in moving it from one position to the other, the current in the magnet being constant; by noting the distance of the movement of the armature the (average) force can readily be calculated; when the distance between *A* and *B* is small the area *ABc* is small and of the second order, and the work done is then equal to *OaAcb*. He then develops the formula in which the force is equal to the area multiplied by the square of the intensity of induction and divided by 8π, when the lines of force are parallel and the displacement of the armature is small and parallel with the lines of force; the work done is the force multiplied by the displacement. In the case in which the induction is proportional to the magnetizing force, as where there is a coefficient of self-induction, the mechanical work done is equal to one-half the square of the current × coefficient of self-induction × displacement; the work done by the current is twice this amount, one-half of it goes to work on the armature and the other to increasing the moment of the magnet; if the inductions and currents are in absolute units the work and the force will be measured in ergs and dynes respectively. (The paper is written in such an abbreviated form that the meanings of the terms are not clearly described; one letter seems to be used for different purposes and there is a misleading typographical error.)

Magnetization at High Frequencies.—A paper by Prof. Klemencic read at the Vienna Academy of Sciences is abstracted briefly in the Lond. "Elec.," May 25; the results show that over the range which he used the permeability had a constant value; that it was not due to the magnetizing forces being small was shown by the fact that at least on the surface of the wire and at the commencement of the oscillations, the magnetizing force exceeded more than one hundredfold the maximum limit within which the permeability is constant; in these experiments there must exist a time lag in the magnetization which should not be confused with the hysteresis.

Hysteresis and Permanent Deformations.—An Academy paper of a mathematical character by Mr. Duhem is briefly abstracted in "L'Ind. Elec.," May 25.

Magnetization by Hertzian Currents.—A paper by Mr. Birkeland is abstracted in "L'Ind. Elec.," May 25.

Resistance of Pure Water.—An article of some length by Profs. Kohlrausch and Heydweiller is published in full in the "Elek. Echo," May 19. They describe in detail the method of producing pure water, the measurements, the properties, a theoretical discussion of the calculation of the conductivity and a comparison of the calculated and the ob-

served results, given in a table for different temperatures and showing close agreement. The conductivity at 0 degree C. of the purest water that it was possible to produce was 0.014×10^{-10}; one millimetre of this water at this temperature has a resistance equal to a copper wire of the same cross-section extending 1,000 times around the earth. The action of the air on the conductivity of the water is surprisingly great; the conductivity increases to over five times the amount when the water is exposed to the air for five hours; the conductivity increases when the current passes through the water; the increase may be as much at 100 per cent., but it falls again and the increase seems to disappear in several hours. The temperature coefficient is great and becomes greater the purer the water and the conductivity increases rapidly with the temperature, in which case it differs from the other conductors.

Resistance Alloys.—A Physical Society paper by Mr. Van Aubel is abstracted briefly in "L'Ind. Elec.," May 25; he calls attention to some patented alloys (possibly of nickel) made in Germany, which have a very high electrical resistance and a small temperature coefficient; the figures for the best one are a resistivity in microhms centimetre of 50.2 and 47.1 for hard and soft wires and temperature coefficients respectively of — 0.000011 and + 0.000005. Mr. Guillaume called attention to an alloy of 68.6 Cu, 30. Mn and 1.3 Fe, which had the greatest resistivity which he could obtain, it being 108 microhms centimetre; it has the advantage of having a very small temperature coefficient which changes signs.

Testing for Grounds.—In a communication to the Lond. "Elec. Rev.," May 25, Mr. Wilson mentions the method used by the Glasgow Corporation, which requires absolutely no disconnections in a complete network of wires; "the direction of the current due to putting on an earth resistance as described" (no description, however, is given) "is noted by laying a pocket compass on the conductor and bringing the needle parallel with it by means of a strong bar magnet before making the earth seeking current"; two men in 1-2 to 1 1-2 hours can trace a ground without lifting more than six or eight junction box lids; he states that the method has been fully described. A ground in a series arc light circuit may be found by first taking the difference of potential between one end of the circuit and the earth, thus locating the fault between two lamps; it may be then located by means of a sensitive portable galvanometer at that part of the line; "a resistance is put in circuit, such that the difference of potential across it is the same as the drop on 100 feet of line. The ratio of the galvanometer deflection, across the resistance, and from line to earth, gives at once the fraction of 100 feet that the fault is distant."

Frequency and Periodicity.—In an editorial in the Lond. "Elec. Rev.," May 25, these two terms are discussed, and it is claimed that the word frequency is applied to the number of single waves or half cycles, and can therefore be applied to the pulsations of a rectified alternating current, while the word periodicity applies to the number of double waves, and that therefore the periodicity is equal to half the frequency; it is stated that these words were taken from the science of the pendulum, in which they are used with these meanings; as both words are not necessary, it is suggested that frequency could be used, as it applies to both alternating and pulsating currents. (It appears that this definition of frequency is different from the universally accepted one; frequency and periodicity are generally used synonymously, both applying to the number of complete waves per second.)

Substitute for Selenium Cells.—In the Lond. "Elec. Rev.," May 25, Mr. Viles suggests as a substitute, a delicate microphone made of two carbon filaments, one resting lightly on the other; a thin magnetic plate, blackened on one side, like the veins of a Crookes radiometer, is attached to the upper filament, and the whole is enclosed in a high vacuum; when light falls on the blackened surface a pressure is caused, which alters the resistance of the circuit; he suggests that it might be used for relays or possibly as a photometer or thermostat.

Standard of Light.—"L'Ind. Elec.," May 25, contains a list of errors, some of which are important, in the original article, of which an abstract was given June 9.

Measuring the Resistance of Electrolytes.—A paper by Mr. McKittrick, from the "Transactions of the Nova Scotian Institute of Sciences," is reprinted in the Lond. "Elec. Eng.," May 25.

Modified Lippmann Electrometer.—The modification mentioned in the Digest May 12 is described and illustrated in "L'Ind. Elec.," May 25.

DYNAMOS AND MOTORS.

Alternating Current Motors.—The translation of the first part of a paper by Prof. Ferraris on "A Method for the Treatment of Rotating or Alternating Vectors, with an Application to Alternate Current Motors," is given in the Lond. "Elec.," May 25, and is highly recommended in an editorial; it relates to a method of treating, by graphical calculations, the quantities occurring in the problems of the rotary magnetic fields; the present portion is of a theoretical character. It consists of a simple and obvious method which may assist in the interpretation and in the elementary explanation of many phenomena; its application is shown in the magnetic field, and by means of it he explains, in another article published in the same journal, an elementary theory of the principles of synchronous alternating current electric motors.

TRANSFORMERS.

Polymorphique Generators and Transformers.—In a well written article by Mr. Hospitalier, published in "L'Ind. Elec.," May 25, he gives a very good classification of generators and transformers, including a brief description of each of the numerous different kinds, and a mention of those in use; the descriptions are devoted exclusively to the polymorphique generators and transformers; by polymorphique generators he means those which can generate successively or simultaneously electrical energy in various forms, and by polymorphique transformers those which receive the energy in one form and convert it into one or several different forms; the usual dynamos and transformers he designated as monomorphique. The classification is complete and includes a description of the transformation of continuous, simple alternating, diphase and triphase currents, each into each of the others. The only new system mentioned is one which has been proposed by Prof. Potier for transforming simple alternating currents into triphase currents, which is briefly as follows: Conceive a simple alternating current motor with closed circuited armature revolving at its normal velocity; the armature develops in the inducing part a field which turns with the same frequency; if the inducing part is provided with a second winding, distributed regularly over the whole periphery, and if three connections be made 120 degrees apart, triphase currents may be led off, thus furnishing a transformation of simple alternating into triphase currents; the same method may be used for transforming a simple alternating current into a diphase current by a mere change in the connections of the wires.

ARC AND INCANDESCENT LIGHTS.

Blackening of Lamps.—In referring to Prof. Anthony's recent Institute paper, Prof. Fleming, in the Lond. "Elec. Rev.," May 25, states that in 1885 he published the conditions under which the deposit is apparently due to a general evaporation, and where it is due to a projection causing a shadow; out of 100 lamps which were blackened, not 5 per cent. showed the shadow; he claims to have shown conclusively that the shadows are either produced by a very

high temperature at one spot or by a localized high temperature in the filament.

Price of Incandescent Lamps.—"L'Ind. Elec.," May 26, calls attention to the fact that at a recent meeting of lamp manufacturers (presumably German and Austrian) it was decided to adopt a minimum price of 18.8 cents for lamps up to 120 volts and 32 candles in lots of at least 5c; for central stations the minimum price is 16.2 cents; it is stated that another meeing will be held in June in which English and French manufacturers are expected to take part.

Watertight Protecting Globe.—A simple device made in Germany is described and well illustrated in the "Elek. Anz.," May 17.

Lamp Base.—A base for lamps with several filaments is described and well illustrated in the "Elek. Anz.," May 13.

TRANSMISSION OF POWER.

Power Transmission in India.—The report of the committee to consider the question of the available power in the Periyar irrigation works in Southern India is published in the Lond. "Elec.," May 25; the fall of the water is 1,200 feet, which will yield 60,000 effective h. p.; it is recommended to divide it into two parts of 500 feet each on account of the great fall and to transmit the power electrically to a distance of from 80 to 350 miles, the greater part being to the town of Madras at the latter distance. Some figures are given regarding the hydraulic machinery, the cost of power, etc. Prof. Forbes made the report on the electrical part of the problem; he prefers the two-phase system, saying that the three-phase system is unsuitable; he prefers a frequency of 10 for motive power purposes, but as a large amount of current is to be used for lighting he has decided on a frequency of 50 periods, although the efficiency of the motors at that frequency may only amount to 85 per cent.; he recommends 5,000-h. p. dynamos as units, having vertical shafts and generating from 30,000 to 40,000 volts, directly; the cost of the dynamos is given as not over $30,000; he states that an alternate current dynamo can be obtained about 40 per cent. cheaper than a direct current machine, when dealing with large amounts of power. The cost of transformers of 1,000 h. p. or over may be taken as not over $5 per horse power, and they would probably not cost more than half this amount; one overhead line (circuit?) is to be used for each unit, and the poles are to be A-shaped; different figures are given for the cost of the line at different current densities; for 400 amperes per square inch, the total cost of the principal parts of the electrical plant are as follows: Copper, for the line, $125; poles and insulators, $31.50; dynamos for 1.46-h. p., $8.75; transformers for 1 h. p., $5, or a total of about $170 per horse power delivered; the annual charge may be taken as $9.50.

High Tension Continuous Current Transmission.—A translation of the article by Mr. Schultz, abstracted in the Digest June 9, is given in abstract in the Lond. "Elec. Eng.," May 25.

ELECTRIC RAILWAYS.

Electricity for Heavy Railroad Service.—In the Lond. "Elec. Eng.," May 25, Mr. Lea criticises the article by Mr. Barnes in the "Railroad Gazette," mentioned in the Digest June 9. He states that Mr. Barnes' figures are not to be considered as representing the utmost or even the average powers of electric working in railway service; the figures 1.8 and 4.2 pounds of coal per horse power hour for good stationary and steam locomotives, respectively, should be stated as referring to the indicated horse power in the cylinders and not to the brake h. p. or the drawbar pull; some reduction ought to have been made in the steam locomotive's efficiency to reduce it to the drawbar pull; he thinks 20 per cent loss for the engine friction, hauling dead weight of engine, etc., is not too much to assume; the percentages of loss which Mr. Barnes gives for an electric line are higher than is actually shown by daily working; the steam locomotive burns at least five and one-half pounds per horse power hour, reduced to drawbar pull, while for the electric line it is about three pounds, full load being assumed in both cases.

Paris Underground Railway.—According to the Lond. "Elec. Eng.," May 25, a definite decision may shortly be arrived at concerning this road; the railway will run from the extreme western part of Paris to the extreme eastern part and will be carried in an iron tunnel 20 feet in diameter.

Worm Wheel Gearing.—The paper abstracted in the Digest last week is criticised by Mr. Kennedy in the Lond. "Elec. Rev.," May 25; he calls attention to a possible printer's error and to other points which are not clear; as the tests were only for a small horse power he suggests that tests up to 20 h. p. would be of interest, as this gearing falls in efficiency as the load increases.

Self-Propelled Vehicles.—One hundred and two different vehicles will be entered in the competitive tests to be held in Paris on the 19th of July, among which are only three or four in which electricity will be used; most of them are to be run with petroleum, as that is the source of energy which it is easiest to obtain during a voyage; "L'Ind. Elec.," May 25, promises a description of the electrical vehicles.

Steam Tramway.—The Serpolet system of steam generation and utilization for tramway purposes is described and illustrated in "L'Elec.," May 19; the steam is generated by forcing water between two hot plates in the form of a flattened tube.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

London Central Stations.—The leading editorial in the Lond. "Elec.," May 25, is devoted to its annual analysis of the capital and revenue accounts of the stations in London; the tables are quite complete and contain the accounts under a large number of sub-divided headings. No attempt at a comparison is made and the tables do not admit of being abstracted, but the following figures are given in the text: The average capital expended per lamp connected is $25, the best individual figure being about $12.50; the aggregate gross income for 1893 amounted to about $1,425,000, and the total kilowatt hours in the meters amounted to nearly 10,000,000, the increase in both cases being about 25 per cent. over the figures for the previous year; the average market price of a kilowatt hour in London last year was 12.76 cents; the average return per lamp connected was about $1.85; the total coal bills amounted to about $274,000, equivalent to about 2.65 cents per kilowatt hour sold or 10 per cent. less than in the previous year; the lowest coal bill per kilowatt hour was that of the Kensington company, and was 1.48 cents, the next being that of the Westminster company at 1.56 cents.

Central Stations in Germany.—The article of Mr. Uppenborn, mentioned in the Digest June 2, is abstracted briefly in the Lond. "Elec. Eng.," May 25.

Destructors.—The report on dust destructors for the electric lighting of the Shoreditch Vestry is given in full in the Lond. "Elec. Rev.," May 25. It is intended to supply steam, not only for the lighting station, but also for baths and wash houses; they estimate that the average daily winter load on the central station may be taken at 100 kw. at the start and considerably less during the summer months, and that the probable annual expenditure in coal for the baths and wash houses would amount to $2,500; a tabulated estimate of the capital required shows it to be $87,500 and the annual saving in adopting the dust destructors instead of using coal is given as $21,650; the proposed plant includes the Halpin storage system, in which the steam is stored (as described in the Digest Feb. 11 and 18, 1893).

Cost of Electrical Energy.—A continuation of the discussion of Mr. Crompton's paper is given in the Lond. "Elec. Eng.," May 25.

WIRES, WIRING AND CONDUITS.

Couplings for Underground Wires.—"Ind. and Iron," May 25, contains an illustrated description of a new screw coupling for underground cables used in England; the wires are screwed together and the joint is enclosed in a screw cap.

Lead Covered Cables.—A machine for making the lead covering is illustrated and described in "La Lum. Elec.," May 19.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Loud Speaking Telephone.—The Graham telephone is mentioned again in the Lond. "Elec. Rev.," May 25, in which it is spoken of very highly; the editors have personally inspected and used them and state that no description can possibly do them justice; they say that they are no laboratory instruments, but simple, reliable, practical telephones which any one can use at once; they believe that this telephone will create a sensation and ought to revolutionize the present systems; that it is an enormous advance on anything they have seen, that the articulation is perfect and the loudness wonderful; the talking can be plainly heard all over the room, and no call bell is therefore required.

Leakage in Telegraph Wires.—The Lond. "Elec.," May 25, contains an article by Mr. Fitzgerald, "On the Effect of Leakage on Wave Propagation in Telegraph Wires; or, Mr. Oliver Heaviside's Theory Explained by Analogy." Analogies are made with the propagation of air waves and the action of balls hitting against one another; the article does not admit of being abstracted; it is written in an easily understood style and is of considerable interest; some of the analogies appear to be new.

Type Printers.—A somewhat detailed description, including 15 cuts of the instrument used by the Exchange Telegraph Company, by Mr. Digby Latimer, is reprinted in the Lond, "Elec. Rev.," May 25.

Electric Clocks.—The Schmehlik master clock for electric time transmission, and itself operated electrically, is described and illustrated in the "Elek. Anz.," May 13.

The Cauderay system of clocks, operated electrically by primary batteries, is illustrated and described in "L'Elec.," May 19.

Pacific Cable.—Another letter in reply to the former one is published in the Lond. "Elec. Rev." and "Elec. Eng.," May 25.

ELECTRO-CHEMISTRY.

Alternate Current Electrolysis.—The Lond. "Elec. Rev.," May 25, recommends highly a Royal Society paper, volume LIV., page 407, by Hopkinson, Wilson and Lydall, for those interested in commercial electrolysis; a very brief abstract is given, in which it is stated that 0.00000007 gram of hydrogen is sufficient to polarize 1 square centimetre of platinum.

Chloride Accumulator.—The article by Mr. Andreoli is continued in the Lond. "Elec. Rev.," May 25; he states that it is an undeniable fact that the first chloride of lead accumulator was made twelve years ago by Mr. Maxwell Lyte, who, however, made solid plates and that he, Mr. Andreoli, was the first to combine the chloride of lead with the grid in 1886.

Minimum E. M. F. for Alkaline Solution.—The Lond. "Elec. Rev.," May 25; recommends a paper by Mr. Nourrison, read at the French Academy of Sciences, in which he establishes and confirms the law that the minimum E. M. F. is constant on the one hand for oxy-salts and on the other for haloids derived from the same acid.

Electrical Dyeing.—Attention is called in the Lond. "Elec. Rev.," May 25, to a paper in the "Chemiker Zeitung," volume XVII., page 1,633, in which a satisfactory method for indigo dyeing is given.

MISCELLANEOUS.

Pumps for Great Pressure.—In "L'Elec.," May 19, a system of centrifugal pumps for great pressures is described and illustrated; an electric motor is coupled directly to two or more centrifugal pumps, which are connected in series, the water, after having passed through one pump, entering the other and receiving additional pressure; the system is in use in France. An abstract of the article is given briefly in the Lond. "Elec. Eng.," May 25.

World's Fair.—The Lond. "Elec. Rev.," and "Elec. Eng.," May 25, give the portion on electricity from the report of the Royal Commission for the Chicago Exhibition.

Electricity and Some of Its Uses.—A lecture by Sir Frederick Bramwell, of an elementary character, is reprinted, with the illustrations, in the Lond. "Elec. Eng.," May 25.

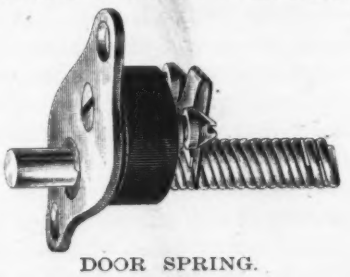
Consumers of Electricity.—An article in the Lond "Elec. Rev.," May 25, discusses the new Users' Association, mentioned in the Digest last week.

Automatic Electrolyzing Machine.—A "nickel-in-the-slot" machine for generating a pulsating current to be taken by the hands is illustrated and described in "L'Elec.," May 19.

The Geary & Mossop Door Spring.

The door spring, shown in the illustration, is one of the latest products of Messrs. Geary & Mossop, Chester, Pa., of which Craig R. Arnold is the selling agent.

This spring is constructed on new principles, avoiding the use of iron or such metals as will rust and corrode, thus affecting the efficiency of the device. The principal deviation is the use of a long phosphor bronze spring, one end of which is fastened in the brass head plate which secures it to the door; the other end of the spring has a small brass washer fastened into it, and located between these ends is a German silver contact strip which is bent in the form of a loop, thus giving great flexibility to the contacts. The binding screws have conical heads and the German silver tongue makes or breaks the circuit as desired between these screws. The wires are fastened under the heads of the latter.



DOOR SPRING.

Should these heads become worn in time by use, they are readily changed to a new position, thereby presenting a fresh surface for contact. The use of the phosphor bronze spring in this shape secures a number of advantages. Instead of the pin being rigid, it is flexible to a degree never before reached, and the German silver tongue is readily changed from one turn to another, and tightens or loosens the contacts as desired.

Quite another advantage that will be appreciated by artisans is the fact that a single bit bored into the frame will admit all of the apparatus; no chisels or other tools are required. The hole which admits the insulating head leaves ample room for the wires to be connected.

A New Transformer Cut-Out.

The Packard Electric Company, Warren, O., has recently placed on the market for use with the Packard transformer a new cut-out, which has been designed to overcome the difficulty in securing a desirable transformer cut-out perfectly safe and convenient to handle and renew, and at the same time securing an absolute and sufficient electrical contact. Fig. 1 shows the manner in which the fuse plugs project from the front of the case, so that they can be easily withdrawn or replaced. Protection is afforded by a hinged cap, which entirely covers and conceals the porcelain handle.

Thus, the transformer can be cut out of circuit and a burned out fuse replaced without the use of any tool whatever. The plugs are made interchangeable, so that a new plug can be

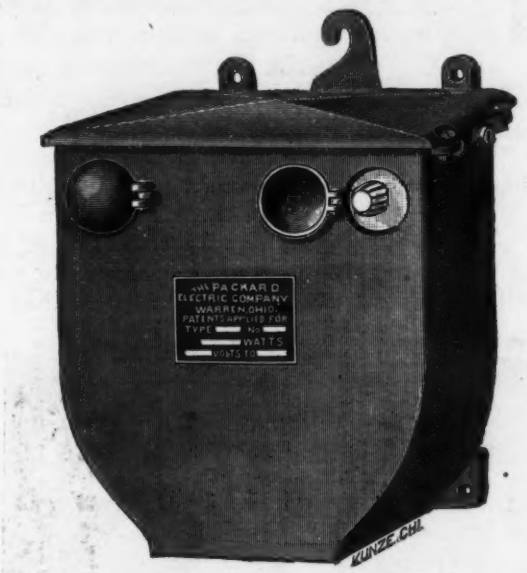


FIG. 1.—TRANSFORMER CUT-OUT.

slipped in in place of the old and the latter can be re-fused for use again at any time.

Referring to Fig. 2, it will be seen that the fuse lies along almost the entire length of the plug, one side of which is grooved for the fuse strip, thus protecting it from mechanical injury in withdrawing or replacing. The plug is provided with two metal lugs, between which the fuse is connected. One of the lugs covers the entire end of the plug; the other extends entirely through the plug, making a double contact with its corresponding metal surface within the cut-out block.

The cut-out block is a piece of porcelain divided into two

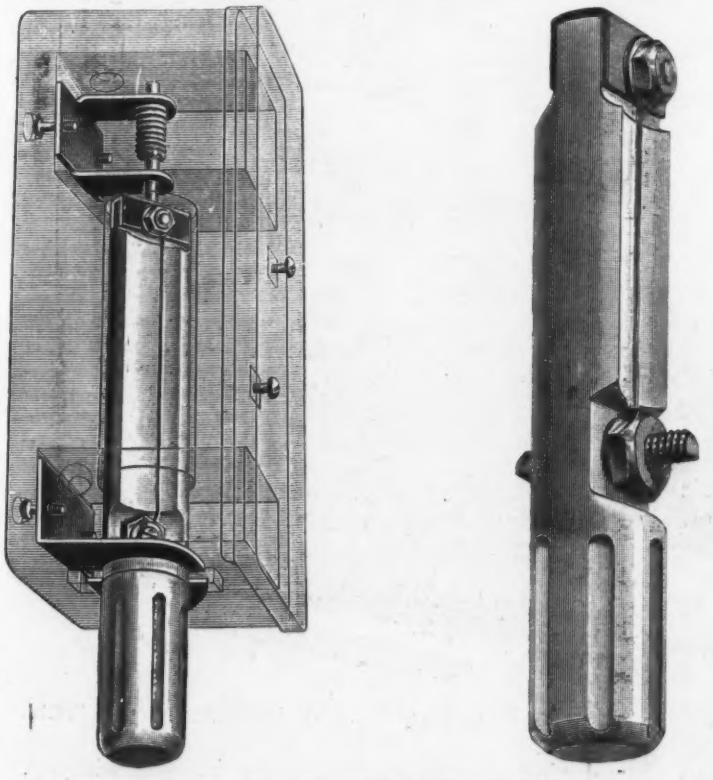
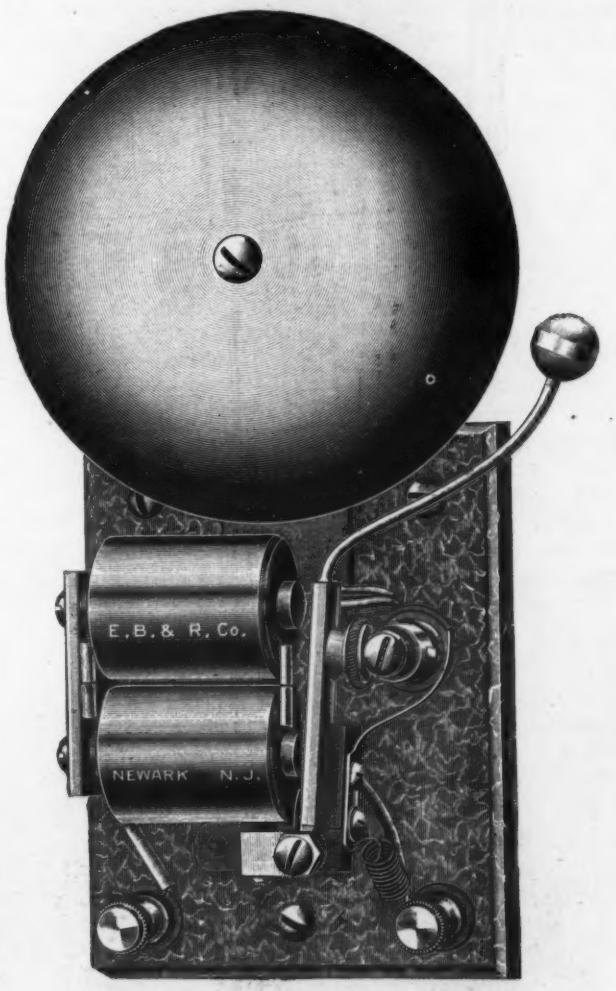


FIG. 2.—CUT-OUT FUSE AND BLOCK.

compartments, seen at either end of the block. In these is made the contact with the two ends of the plug. To insert the plug it is held with the projecting lugs in a perpendicular position, so that they will pass through the slots shown in the first contact plate within the block. As the end of the plug comes in contact with the rod carrying the spiral spring in the second compartment, a slight pressure is necessary. This forces the spiral spring back, making a perfect contact with the metal rod at that end and allowing the double lug of the plug to pass through the two slots in the first contact plate above mentioned. A quarter turn to either the right or left throws the double lugs firmly against the first contact plate, where they are held by the pressure of the spiral spring at the other end of the plug. It will be thus seen that a perfect contact is assured at both ends of the plug.

Electric Bells on Lighting and Power Circuits.

To obviate the expense and trouble in using batteries to ring bells where dynamo circuits are available, the Electric Bell and Resistance Company, Newark, N. J., is now placing on the market bells to work on circuits of from 50 to 500 volts, either direct or alternating, and without external resistance. The novel features in these bells consists in winding a new high resistance conductor on the outside of magnet coils, and so connecting it that there is no inductive spark at armature contacts, a feature which will be readily appre-



BEL LFOR ELECTRIC LIGHT CIRCUIT.

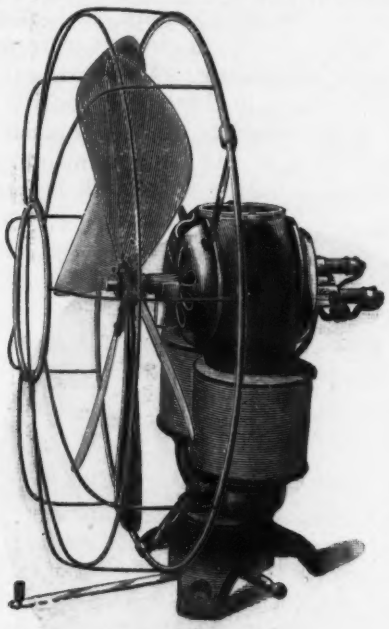
ciated by users of bells. Among the advantages aside from getting rid of the nuisance of batteries is the saving in cost of wiring, as in most cases it is only necessary to wire the bell circuits with one wire instead of two. This is accomplished by connecting the push button to the nearest service wire and running a single wire to the bell, and from thence to the nearest service wire from that point. The bells are wired the same as ordinary lamps, and have cut-outs in circuit, and with the above method for wiring the number of wires as well as trouble from bad wiring are diminished. Fire risks are lessened, as in case of a cross with another circuit or

ground, the bells do not burn out and set fire to the adjoining woodwork, but ring and call attention to trouble on the line. There is no inductive spark to oxidize the contacts, and no adjusting is required for weak or strong batteries: bells once adjusted always remain so. The bells are mounted on a marbelized slate base, which insures perfect insulation, and present an appearance and finish much superior to that of ordinary bells.

The same company is just placing on the market a 500-volt alarm bell for trolley cars, motormen's signals which have no external resistance.

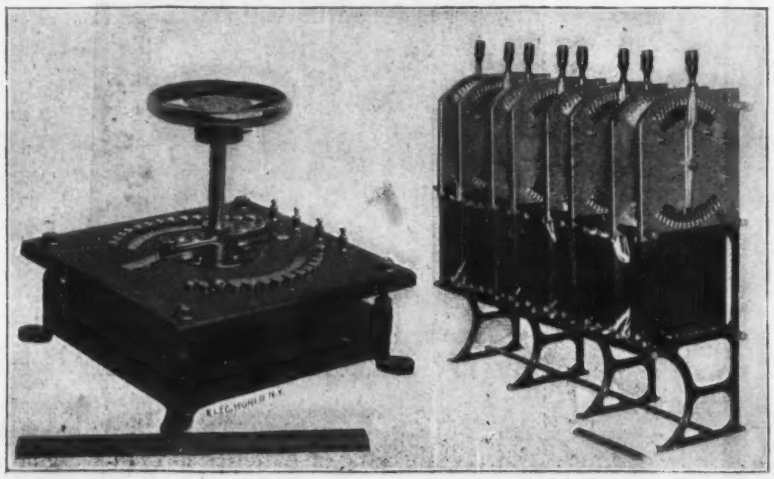
Electric Fan Motor.

The type of the armature adopted in the fan motor illustrated, manufactured by Roth & Eck, 30 Market street,



FAN MOTOR.

Chicago, is a Gramme ring proportioned with a view to maximum efficiency. The brushes themselves are small carbon pencils, fitted in adjustable holders and are self-feeding; they require little attention and can be replaced at any time for one-tenth the cost of copper brushes. The commutators are made of gun metal carefully insulated with mica. The speed can be regulated by the switch, giving three speeds, 2,000, 1,400 and 800 revolutions per minute. The motor is placed upon a tripod swivel base and can with little exertion be turned to face in any direction. The guard is made of heavy stiff brass wire and attached to the field casting in three places. The current required for the 1-8-h. p. motor is equal to that used by one 16-c. p. lamp. The motor has self-oiling bearings, and a few drops of oil properly applied will lubricate it for a month.



FIGS. 3 AND 4.—SWITCH AND THEATRE DIMMER.

We illustrate herewith some new and interesting apparatus of the Carpenter Enamel Rheostat Company, of Bridgeport, Conn.

Fig. 1 shows a new automatic switch, just placed upon the market by this company. The switch is shown in the position of "motor stopped," and also "motor running." To start up the motor the operator takes hold of the round wooden handle attached to the armature of the magnet and

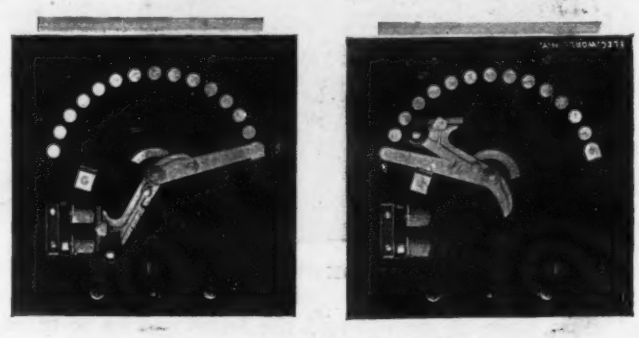


FIG. 1.—AUTOMATIC SWITCH.

moves it through about 120 degrees before the rheostat lever moves at all. In moving the handle through the next 120 degrees the rheostat lever moves over the rheostat contacts, gradually cutting out the resistance in circuit with the motor armature. The automatic switch will then be in the position shown by the illustration "motor running," all of the resistance being cut out and the armature being in contact with the electromagnet, which is excited by the current going to the motor. If for any cause the current supplying the motor should fail, the electromagnet loses its magnetism, and the keeper arm, actuated by a coiled spring, flies back,

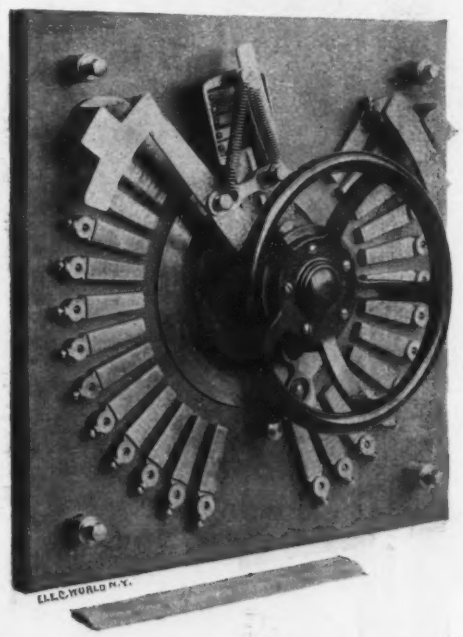


FIG. 2.—REGULATING AND REVERSING SWITCH.

and after moving through 120 degrees it engages with the rheostat lever and the momentum of the keeper arm, together with the action of the coiled spring, drives the rheostat lever to the position "motor stopped" again.

By the use of this automatic switch, the burning out of a motor armature due to improper starting up or due to sud-

den application of current after temporary interruption in the service is entirely obviated. The switch is well designed and very compact.

Fig. 2 shows a regulating and reversing switch for traveling crane and elevator motors of large capacity, say, 30 kw., and has novel features, insuring freedom from sparking at the contacts upon reversal of current.

Fig. 3 shows a similar rheostat for a motor of 1 kw., such as are used upon jib cranes.

Fig. 4 shows a bank of theatre dimmers of the latest type of the Carpenter company. These theatre dimmers have already become standard because of their compactness and safety as regards fire.

Two-phased System for Lighting and Power.

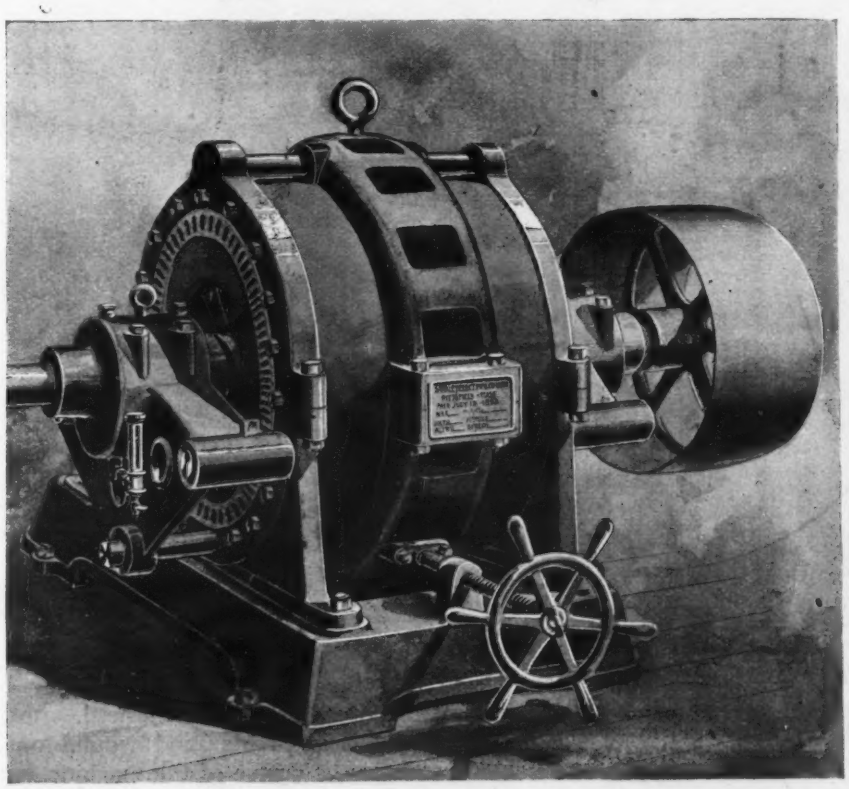
For the past three years the Stanley Electric Manufacturing Company, of Pittsfield, Mass., has been quietly at work perfecting a two-phased alternating current system for the distribution of light and power indiscriminately from the same generator and circuit and at even the highest commercial frequency. The determination to offer nothing for sale until the system had by actual and prolonged commercial use been demonstrated thoroughly practical and entirely out of the experimental stage has been adhered to. This unusual course has delayed placing the system on the market, but, on the other hand, insures a commercial confidence not ordinarily given to new systems.

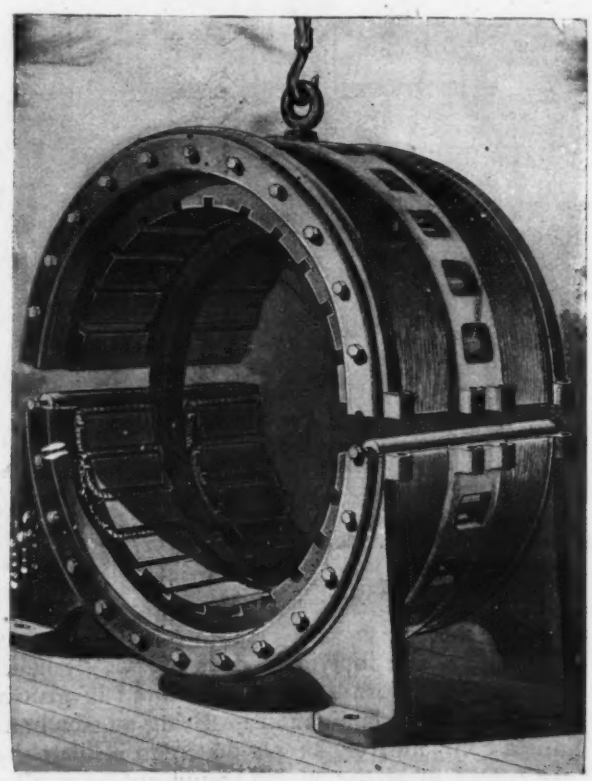
The objects kept in view by the inventors were, first, the production of a system which would permit of an economical and satisfactory service of both light and power from the same alternating generator and circuit, and one of such a character that existing light companies could operate it without discarding their present apparatus; second, a system which would make it possible for those just starting in the business to equip a station with one class of apparatus for all purposes, thus avoiding the multiplication of both circuits and apparatus necessary in the past when a company desired to furnish not only incandescent and arc lights, but power; third, to make possible the commercial transmission of the energy of water powers over long distances and the distribution of the same for lighting and power by a simple system not requiring the duplication of apparatus and many conversions, with consequent waste, made necessary by other plants heretofore operated.

The various apparatus included in the system are the joint invention of Mr. William Stanley, Mr. John F. Kelly and Mr. C. C. Chesney, and so closely have their labors been intertwined that the company has adopted the three initials "S. K. C." as the distinguishing mark of the various devices included in the system.

A great disadvantage of the alternating current system of distribution as heretofore applied has resulted from its not being able to furnish power service from the same mains and thus necessitating, where there is a demand for power service, the instalation of direct current machinery and a separate system of distribution. With the system here described a lighting company may very largely increase its earning capital by being able to install motors on its lighting circuit. It is considered a safe statement to make that in the majority of towns of any size more can be made by furnishing power than light, as the demands of the former are fairly steady for from eight to ten hours, whereas the maximum lighting service averages only three to four hours.

The inventors call attention to the fact that their two-phased generators are fully as good and simple for lighting purposes as single-phased machines and can be used interchangeably with the present single-phased machines, and, in fact, fit in with existing systems just as well as new single-phased generators. By adding one of these generators to its present equipment and by combining the two existing circuits at the station switchboard, or, at the worst, by adding one or two more small line wires, a station can be equipped for furnishing light and power indiscriminately and when the hours of power service are heavy the two-phased machine can be run on two or more ordinary two-wire single-phased circuits just as well as one or two of the old single-phased machines can be run on them. It is not necessary to throw anything away, as the present transformers and generators are just as good and useful with the proposed system as with the original ones.





FIGS. 1 AND 2.—TWO-PHASED GENERATOR AND INDUCTOR.

Stress is laid upon the important element in this system, that as motors are started and stopped, or their loads increased or decreased, lights on the same circuit are not perceptibly influenced; also upon the fact that this system can be used with the highest frequencies, thus securing the great advantages possessed by high over low frequencies in first cost, superior regulation and economy of operation of transformers.

A detailed description of the principles of the two-phased condenser system of this company appeared in The Electrical World of April 29, 1893, and we illustrate herewith the more important apparatus which have since been perfected or designed for its commercial working.

The generators, of which we illustrate in Fig. 1 the type for 60 kw. and 120 kw., are all of the same electrical design, but have, however, a somewhat different mechanical structure in the larger and smaller types. The revolving part of this machine, which is shown in Fig. 2, is really the field, but is more properly termed the inductor. This is made of a steel casting upon the periphery of which polar projections of iron laminae are securely fastened. There is no wire whatever on this inductor, and consequently trouble is obviated from band wires, insulation and collectors, it being simply a mass of metal which can be put in place and revolved with a feeling of perfect certainty that nothing can happen to it.

The armature, shown in Fig. 3, is made up of laminae of iron and is stationary, constituting, in fact, the body of the machine. The individual coils are very small, are wound separately on forms and then secured in grooves provided for them in the laminations. Being so small and stationary it is a comparatively simple matter to insulate them to safely withstand E. M. Fs. which would not be at all safe to generate in the older types of alternating machines. If a coil should be destroyed by lightning or any other cause, it can be readily replaced by the ordinary men employed about a station, as can be seen by reference to the cut. In the small machines it is only necessary to take off the top half of the bearings, lift off the top part of the armature and raise the inductor, when all the coils are easily accessible. In the machine of 240 kw. capacity, and larger, the great weight of the parts would make this plan very inconvenient in many stations, so removable side tables are furnished with this type and by turning hand screws on each side the machine can be drawn apart and all the armature coils exposed and made easily accessible. This does not require disturbing the inductor at all, which when the machine is opened simply hangs in its place in the bearings. The side tables need not be kept in place except when needed, as they are removable. No special tools or appliances are necessary in any case to insert a new coil such as are required with the toothed armature type of machines on the market, in which the coil has to be forced under the teeth to keep it from being thrown out of place by the centrifugal force due to the rapid revolution of the armature.

The bearings, also shown in Fig. 3, are of the most approved self-oiling type, constructed of the best materials and very generous in dimensions.

The armature and field wires are brought out from the machine to a terminal board, shown in Fig. 1, from which the leads are taken out. With this arrangement no wires of any kind are shown festooned about the machine, everything being shipshape and neat. The terminal board consists of two heavy slabs of marble, one secured to the machine and the other forming a removable cover. This cover on its inner face is divided into partitions so that, when in place, each terminal is in a compartment by itself. It is so arranged that fuses may be inserted in the leads, if desired, as an extra precaution against short circuits. This substantial, neat and convenient form of leading the wires out of a dynamo is made possible by the entire absence of collectors or commutators. By simply changing the connections on the board the armature coils may be connected either in series or parallel, so that the standard machines may be connected for either 1,000 or 2,000 volts, as desired.

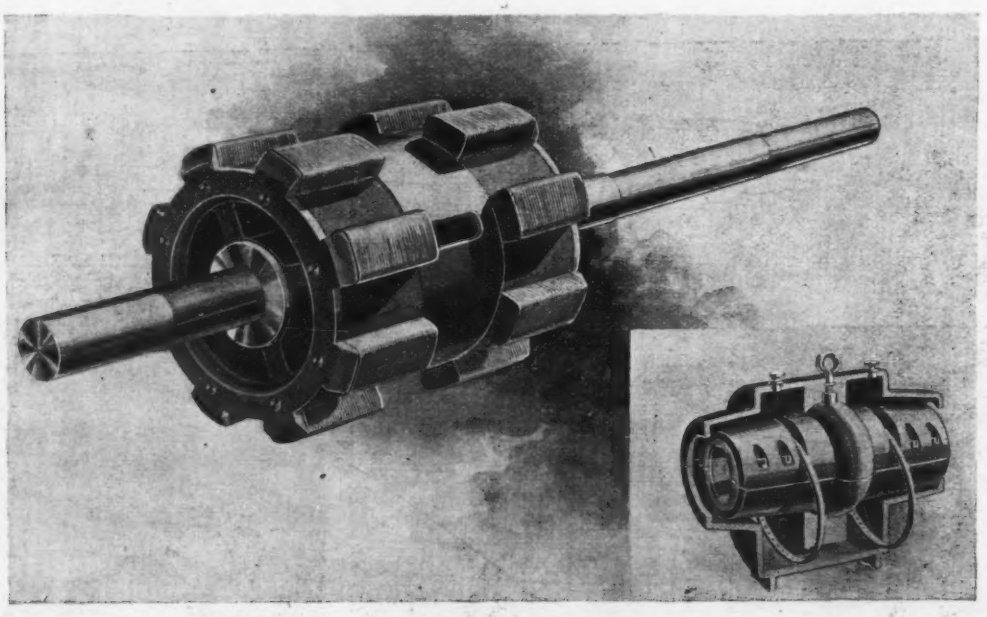


FIG. 3.—ARMATURE OF GENERATOR.

The field or exciting coil is circular and wound on a copper spool, which rests in the centre of the machine, surrounding the inductor. It is thus easily insulated to a very high degree and, being enclosed on three sides by the heavy copper spool, danger of breaking down of the insulation due to a discharge, caused by a breaking of the field circuit when it is fully charged, is practically removed.

The following efficiencies are given for the several types of machines:

	60 kw. Per cent.	120 kw. Per cent.	240 kw. Per cent.
Efficiency at full load	94	95	96
" " half load	91	93	94
" " quarter load	85	88	90

Having but one exciting coil, and so placed as to secure the best magnetic conditions, a degree of economy is obtained in the excitation of the machine which is not possible

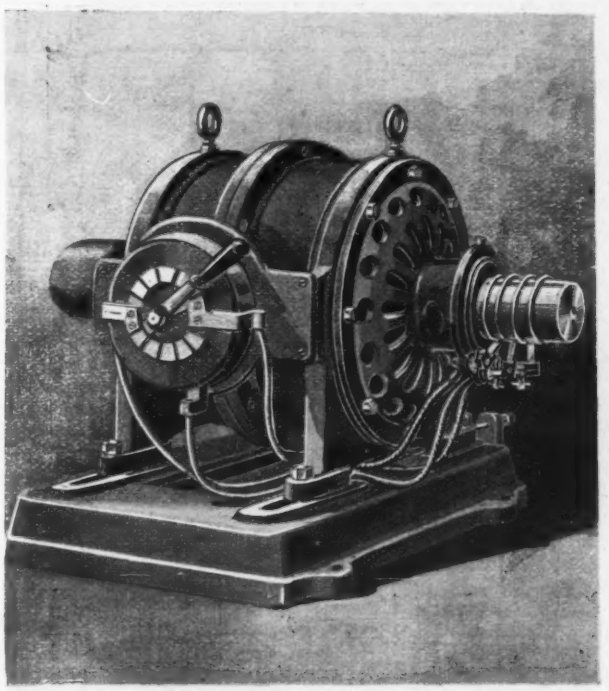
with the older types of generators. Steel and wrought iron laminations are used where other generators are composed of cast iron, and there being no moving wire it is safe to run this type with a closer clearance than is advisable with other machines, even of toothed armature construction. The design also permits very readily of abundant ventilation, so that it runs unusually cool, not only because of this superior ventilation, but also on account of high efficiency. The maximum rise in temperature above the surrounding atmosphere is not more than 50 degrees Fahrenheit in any part of the machine after a continuous run of 24 hours at full load.

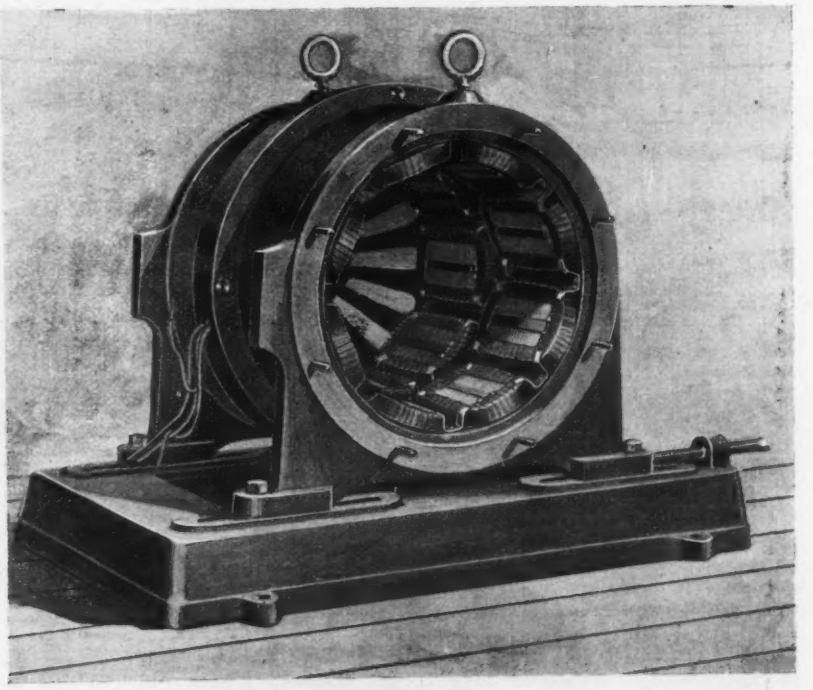
One of the most important properties of the machines is their inherent regulation. The designers have proceeded on the theory that compounding in itself is an unquestioned disadvantage, as it complicates the generator and makes commutation necessary; while it has been necessary, however, in the older types of alternating current generators not regulating otherwise within 30 or 40 per cent., the new type of generator has an inherent regulation of from 6 per cent. to 9 per cent., depending on the size of the machine and the margin of E. M. F. desired. With one of these machines the full load, excepting one lamp, can be thrown off instantly, it is claimed, without materially increasing the brilliancy of the one remaining lamp (provided, of course, the speed of the machine is constant), and this is accomplished without any extraneous regulating device whatever. It is claimed that there is no possible advantage in compounding when two or more circuits (with 10 per cent. or more loss when fully loaded) are often supplied by a single generator at times when one of them may be fully loaded and the others half or quarter loaded. The vexing problems of distribution are solved by using a closely regulating machine, and by being more liberal in the use of copper in the line. This liberality will pay for itself many times over by saving in operating expenses, by saving the first cost of all sorts of devices and by saving in repairs.

With the generator and transformers of this company, a line with a loss of 2 per cent. and good secondary wiring, it is claimed that absolute simplicity and reliability is attainable.

As has been pointed out by the inventors of this system, by Kennelly and others, the shape of the current wave generated by a machine is of great importance in order to obtain the best economy in transformers and in the operation of motors by alternating currents. Some of the original types of alternators used in this country, with the surface wound armature, produced a very good form of wave, but the so-called toothed armature machines (now adopted by all the principal manufacturers in order to obtain higher efficiency and less cost per unit of output) distort the wave so that instead of being in the form of a sine curve it is jagged and irregular. In the generator described the poles, both on the armature and inductor, being stamped out of sheet iron by dies, are all exactly true and perfectly formed, and as the armature is stationary there is no need of overlapping teeth to hold the coils in place, consequently the form of the current wave produced is what it ought to be theoretically, that is, a sine curve. In operating motors commercially, this is of great importance, as it permits of the more complete elimination of the false currents. In the ordinary operation of lights it is also important, because with a current of this character the energy lost in the iron of transformers (core loss in watts) is about 10 per cent. less than with the usual form of current supplied by other types of alternators.

If it is desirable to run alternators coupled in multiple it can be more easily accomplished with this generator, from the fact that the poles on any two or more machines, both on armature and inductor, being necessarily exactly alike, the form of current wave must be the same from all the machines and coincide at all times. The remarkably close regulation of the machines is also an important factor in this connection.





FIGS. 4 AND 6.—TWO-PHASED MOTOR AND FIELD.

The alternating current motor that shall fulfill the conditions imposed by commercial service must possess the following characteristics: It must start from any position of rest with a torque considerably greater than its running torque; it must maintain an approximately constant speed under maximum variations of load and its operation must not unduly disturb the potential of the system. The further qualities of simplicity of construction and operation and of efficiency in converting electrical energy into motive power are, of course, necessary.

It is thus evident that synchronous motors cannot fulfill these commercial requirements, for they cannot start from rest with sufficient torque. Alternating current motors of the induction type, either for single or multiphase circuits,

have the disadvantages due to the false currents developed by such motors; the difficulty of making them with good starting torque without producing very excessive false currents, and the impossibility, because of these false currents, of producing a comprehensive system for both light and power fed by the same dynamo and circuits. These false currents react on and abnormally demagnetize the generator and transformers, thus introducing difficulties in regulation. They also would make necessary the use of generators, lines and transformers disproportionately large for the work to be done. In a commercial system for distribution of light and power widely throughout the city, motors which take current about in proportion to their load are essential.

Another reason why alternating motors have not been introduced in this country has been because of the high frequency here adopted, at which the false currents are much greater than with lower frequencies, and their disturbing features more difficult to overcome. One object of the Stanley company has been to produce a motor which would be commercial on the standard frequencies used in this country in order to, in a great many places, simplify the problem of adopting multiphase apparatus because of the vast amount of money already invested in generators and transformers only adapted for this high frequency.

The "S. K. C." motor, shown in Fig. 4, is novel and its principle of operation may be best described as consisting of two parts, a motor proper and a rotating transformer, the two parts alternately exchanging their functions. It consists electrically of two fields, which are fed by currents differing 90 degrees in phase, and two armatures, though mechanically there is but one, as shown in Fig. 5. The winding is so connected that the wire which lies directly under poles on one armature is in series with the wire lying between poles on the other. It is clear that in this position one-half the machine acts as transformer and the other half as motor. The motor armature is shown wound and unwound in Fig. 5. The armature winding is not connected with the circuit, and consequently the only current flowing in it is an induced current.

The field construction is accurately shown in Fig. 6. The coils are wound separately and then secured in place. These coils are the only part of the motor connected with the circuit. Being stationary, they are easily insulated to a high degree. The applied E. M. F. on the coils is 500 volts. The same cut also shows what we term the "compensating winding," which consists of short circuited coils of high conductivity placed in the field poles for the purpose of neutralizing the self-induction of the armature. This construction increases the starting torque of the motors so that in the standard motors of different sizes at starting a torque is obtained which varies from 50 to 200 per cent. greater than the running torque at full load.

The most unique and striking feature of this motor system is the use of the condenser, the function of which is to make the motor take current in proportion to its load substantially as direct current motors do. The condensers are connected in multiple with the fields of the motor, and when so placed they supply the lagging component of the current, or, in other words, the false current. Thus, with this arrangement the false currents, instead of flowing back through the transformer line and generator, thereby disturbing the whole system, simply flow in a local circuit through the condensers. This enables alternating current motors and lights to be operated successfully from the same generator and circuit. Without condensers it is claimed that alternating current motors cannot be operated on the same circuit with lights on currents of high enough frequencies to meet other commercial conditions, and that there is no other company which even claims to have motors for currents of 15,000 or 16,000 alternations, nor any other motor which is being or can be successfully operated on currents of even 7,000 or 8,000 alternations and permit of lighting service from the same circuit at the same time. The condenser in use is no trouble and does not complicate the system. When once set up in place there is nothing to do to it, being like a transformer in this respect. Much study has been given for the past two years by the Stanley company to the manufacture of condensers, for commercial use with its motors, with the result that they are now guaranteed thoroughly reliable and inexpensive.

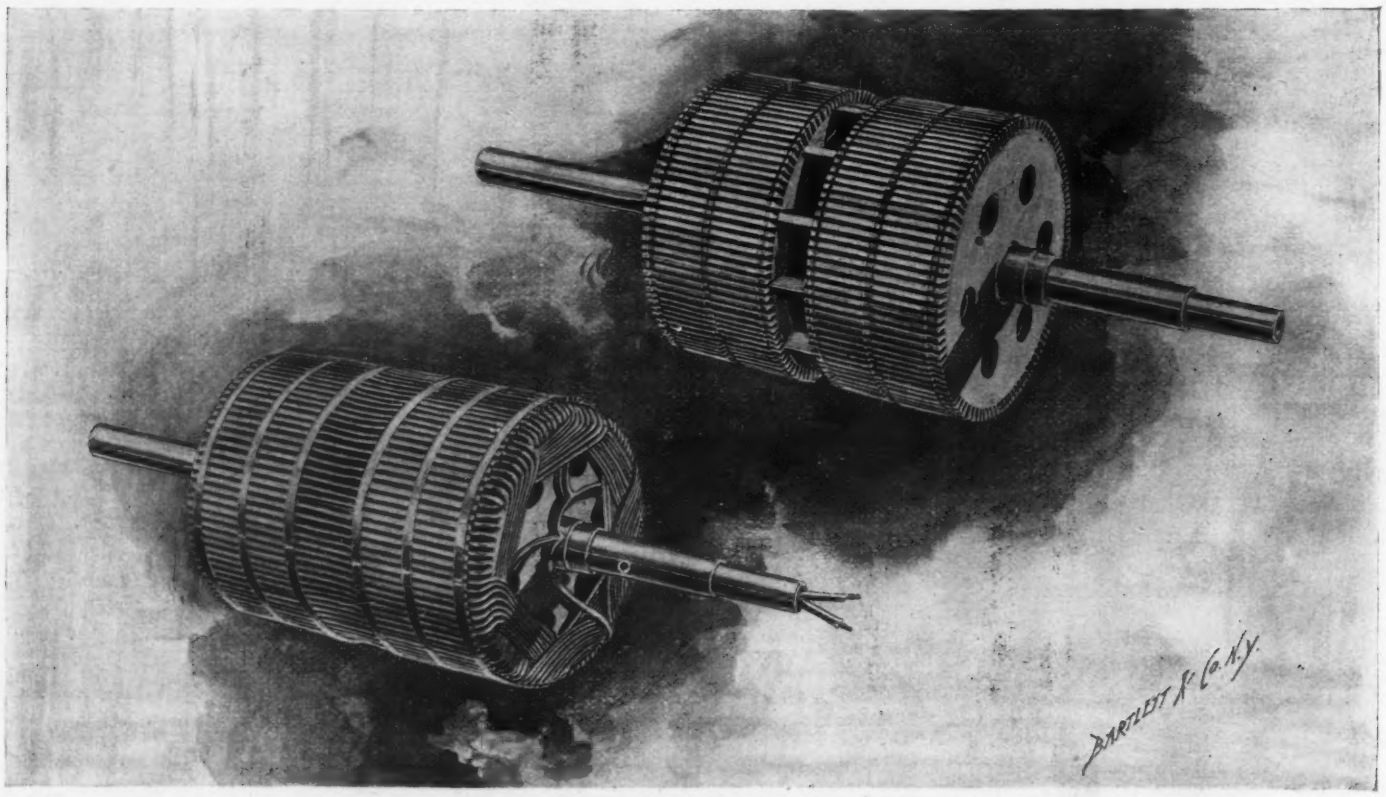


FIG. 5.—TWO-PHASED ARMATURE.

Financial Intelligence.

The Electrical Stock Market.

NEW YORK, June 9, 1894.

GENERAL ELECTRIC has displayed unusual strength in a fashion at times to mystify people. The most important development this week in connection with the General Electric Company has been the placing of the Fort Wayne Electric Company in receivers' hands. That the collapse of the Fort Wayne was not unexpected by the General Electric people is evidenced by the fact that in the annual report recently promulgated the management put the entire holding of Fort Wayne stocks at a valuation of $1. The wisdom of this conservative anticipatory action is now amply demonstrated, and the discounting in this heroic fashion of the value of the 76,874 shares of Fort Wayne Electric stock owned on Jan. 31 has prevented the news of the receivership from having any depressing effect on General Electric stock. The only unfavorable development, viewed from the General Electric standpoint, has been the endeavor of the Fort Wayne people to escape an attachment for $500,000 loaned by the General Electric. The Fort Wayne people claim to have reorganized their property so that the attachment is not, they say, binding. The break between the two companies fully bears out, however, the prediction made in these columns in the beginning of the year that a rupture was pending. Outside of the attention attracted to General Electric by reason of its former close relations to the Fort Wayne, the stock has been worth watching this week by reason of the operations of what is understood to be a new and powerful bull pool. The buying of the stock was started by the covering of short contracts put out some time ago. Little long stock has come out on these raids, however, and the total absence of liquidation has induced traders to buy for a time. The newly formed bull pool has been quick to make good use of this bear scrambling, and the result has been a show of strength hardly comforting to such operators as are still short. The directors are soon to hold a meeting to consider the impairment of capital and dividend questions.

THE FORT WAYNE ELECTRIC COMPANY'S officials say that the placing of it in the hand of A. J. Miller, of Fort Wayne, and E. J. Hathorne, of Boston, as receivers, was done as a preliminary measure to reorganization. Already the Fort Wayne Electric Corporation has been formed to succeed the old company, taking up all its assets. The new concern has a capital of $1,500,000 as compared with the old company's capital of $4,000,000. The officers also assert thatthe receivership is for the purpose of readjusting friendly relations with the General Electric Company, which owns nearly half of the 160,000 shares capital stock. In some quarters, however, it is hinted that the receivership is a deal more important than appears on the surface. It is claimed that, if successful, "it means a new electric company controlled and managed by the old Thomson-Houston people, and to be an active competitor of the General Electric Company." So a party said to be well informed puts it. Naturally the stock has been adversely affected by the receivership. Last week it was $3.50 per share bid; now there is no bid at all, and it is freely offered at $1 or even 50 cents per share.

WESTINGHOUSE ELECTRIC issues hold their own. The board of directors meet on June 27 to consider the dividend question. The talk is a little less certain this week about the declaration of a dividend on the common stock, but there is no doubt as to the big business being done by the Westinghouse company. The officials say that shipments continue above recent averages. The company is also preparing for a new and vigorous campaign of competition for local business. This is to be accomplished by means of the United States Illuminating Company, the local representative of the Westinghouse. The magnificent and efficient plant used at the World's Fair has now been completely installed in the United States company's power house, and everything is ready to supply a much improved arc and incandescent light service. The transmission of power is also a feature of the new plant. Mr. Geo. W. Hebard, who is now a director of both companies, is to be made president of the United States Company, and it is his intention to fully advance Westinghouse Electric business in New York. Mr. Jackson, who is now president of the company, will remain with it as general manager, and the name of the corporation will be changed to the United Electric Company.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES this week made another purchase of preferred stock, 513 more shares being purchased at an average price of $97.41, as against an average price of $96.09 for 624 shares on May 20. This makes a total of 10,468 shares of preferred stock retired to date out of profits arising from dividend and interest payments on treasury assets.

POSTAL TELEGRAPH stock has been in some request this week on renewed reports of increasing earnings and the company's improved facilities as an efficient and quick distributor of telegraphic matter.

WESTERN UNION TELEGRAPH, with the departure of the Goulds for Europe on their yachting experiment, has been neglected. The directors meet next week to declare the dividend, and will prove by making the regular 1¼ per cent. distribution how unfounded the talk of a reduced rate was.

AMERICAN BELL TELEPHONE continues in high favor. The bill for providing for the increase in the capital stock has passed the Massachusetts House of Representatives, and now goes before the Senate. The bill has met with considerable opposition, as it allows the stock of the Bell company to be increased free from all restrictions usually placed upon corporations of its class. It looks now, however, as if the Senate would favor the bill, and when it becomes a law the company will issue the stock in $5,000,000 blocks until the whole $30,000,000 are put upon the market. Meantime present quotations are well held on the belief that even if the bill is finally passed with more restrictions attached it cannot materially diminish the earning capacity of the company. The talk of a possible cutting of dividends during the current year is pronounced ill founded. People supposed to be well informed are looking for an extra $3 on July 1, and believe that the present rate will be continued for some time. Earnings are excellent, even in these dull times, and of late have shown a most satisfactory improvement.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Detroit Electrical Works	10	2	3
Cleveland General Electric Co.	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref.	15	15	16
" " " com.	15	15	17½
Edison Electric Ill., New York	100	99½	100½
" " " 1sts.	—	106	106½
Edison Electric Ill., Brooklyn	100	102	103 *
" " " Boston	100	117	118
" " " Chicago	100	130	135
" " " Philadelphia	100	125	127
Edison Electric Light of Europe	—	—	3
" Bonds	—	80	85
" Ore Milling	—	10	13
Fort Wayne Electric	—	1	3
General Electric Company	100	37⅞	38
" " " deb. 5's	—	86½	87
Interior Conduit and Ins. Co.	100	45	55
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	36½	37
" " " pref.	50	51½	52
Western Union Telegraph	—	85	85⅛
American Bell Telephone	—	198	199

*Ex. Dividend.

New Incorporations.

THE NEW ELECTRIC POWER AND LIGHT COMPANY, San Francisco, Cal., capital stock $10,000,000, has been incorporated.

THE ELECTRIC KINDLING WOOD COMPANY, State Line, Miss., capital stock $15,000, has been incorporated.

THE MONROE CITY TELEPHONE COMPANY, Monroe City, Mo., capital stock $3,000, has been incorporated.

THE POPPOWITSCH ELECTRIC COMPANY, Jersey City, N. J., capital stock $100,000, has been incorporated.

THE MUTUAL AUTOMATIC TELEPHONE COMPANY, Camden, N. J., capital stock $200,000, has been incorporated.

THE ELECTRIC TELEPHONE CONSTRUCTION COMPANY, Cincinnati, Ohio, capital stock $10,000, has been formed.

THE MONTEREY AND STAUNTON TELEPHONE COMPANY, Monterey, Va., capital stock $5,000, has been formed.

THE SUBURBAN ELECTRIC LIGHT AND POWER COMPANY, Little Rock, Ark., capital stock $50,000, has been incorporated.

THE UNION ELECTRIC COMPANY, Cleveland, Ohio, capital stock $25,000, has been formed to manufacture electrical and mechanical apparatus.

THE TEXAS BURGLAR AND FIRE ALARM COMPANY, San Antonio, Tex., capital stock $10,000, has been formed to maintain a telegraph and telephone line, etc.

THE SOUTHERN TELEPHONE CONSTRUCTION COMPANY, Bennettsville, S. C., has been organized with B. Hawkins as manager and W. R. Hawkins electrical expert, to do all classes of telephone construction.

BABYLON, L. I.—The Montauk, Orient and New York Telephone and Telegraph Company has been incorporated, and will connect Orient and Montauk with New York. John Bagshaw and Orange T. Fanning are interested.

THE BRADFORD ELECTRIC STREET RAILWAY COMPANY, Bradford, Pa., capital stock $100,000, has been formed to construct, maintain and operate a street railway. The promoters are W. R. Weaver, C. P. Collins and L. E. Hamsher.

THE OCALA ELECTRIC LIGHT AND POWER COMPANY, Ocala, Fla., capital stock $25,000, has been formed to maintain and operate a plant for light, power, etc. J. A. Bishop, H. L. Anderson and C. Thalheim, all of Ocala, are interested.

THE McDONALD MANUFACTURING COMPANY, Chicago, Ill., capital stock $5,000, has been formed to manufacture and sell annunciators and all forms of electrical specialties and appliances. A. R. Warner, Frank Hamlin and Wm. C. Boyden are interested.

THE RYAN DYNAMO COMPANY, Hamilton, Ohio, capital stock $10,000, has been formed to manufacture and deal in electrical machinery and apparatus, etc. The promoters are C. L. Cornell, J. M. Beeler, E. G. Ruder, J. B. Cornell, Jr., and L. A. Becker.

THE LAMPASAS WATER, ICE AND ELECTRIC COMPANY, Lampasas, Tex., capital stock $30,000, has been formed to furnish

the public with water, ice and electric lights. W. L. Vining, J. W. Martin, C. A. Juhlin and C. L. Morgan are the promoters.

THE SWEET ELECTRIC AND MANUFACTURING COMPANY, Grand Rapids, Mich., capital stock $100,000, has been formed to manufacture and sell machinery and electrical appliances. C. G. Kritser, S. Barnes and D. F. Smith, all of Grand Rapids, are interested.

THE TERRE HAUTE ELECTRIC RAILWAY COMPANY, Terre Haute, Ind., capital stock $500,000, has been formed to operate an electric railway. P. P. Thomas, J. G. McNutt, M. F. Burke, Russell B. Harrison, T. Moore, Jr., and T. A. H. Hay are interested.

THE LOS ANGELES, PASADENA AND ALTADENA RAILWAY COMPANY, Los Angeles, Cal., has been incorporated by G. G. Green, Woodbury, N. J.; Andrew McNally, Chicago, Ill.; C. P. Stewart, Baltimore; G. H. Barker, Philadelphia, Pa., and others. The capital stock is $1,000,000, and it is intended to build and operate a line between the points mentioned.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, June 11, 1894.

THE LEWIS ELECTRIC COMPANY, formerly at 120 Broadway, has removed to 80 Broadway.

THE BROOKLYN HEIGHTS RAILROAD COMPANY carried nearly 400,000 passengers on Sunday, June 3, on its various lines.

A. S. DE VEAU, manufacturer of telephones, reports business very good, having orders for several hundred instruments on hand.

THE SAFETY INSULATED WIRE COMPANY is preparing to move to 225 to 239 West 28th street, where it will have better facilities for supplying the increasing demand for its well known wire.

MR. R. E. DIFFENDERFER, general manager of the Standard Electric Company, Philadelphia, was in town last week. Mr. Diffenderfer will have something interesting to show to the electrical trade very soon.

THE MOTORMEN of the Consolidated Traction Company, at Newark, N. J., have had their eyes examined, as the numerous fatal accidents on the trolley lines at Newark are said to be largely due to defective eyesight on the part of the motormen.

THE BOARD OF ALDERMEN of Brooklyn has overriden Mayor Schieren's veto of the telephone franchise granted to the New York and Eastern Telegraph and Telephone Company. The mayor wished the franchise amended to better secure the city's interests.

MR. J. W. HOLLOWAY, of the Warren Electric and Specialty Company, Warren, Ohio, arrived in the city last week and expects to remain in this vicinity for about 10 days, visiting his family, who live on Staten Island, and attending to the business of the company.

THE ARGUMENT on the motion of the Consolidated Electric Storage Company against the Electric Storage Battery Company, manufacturers of the chloride battery, for a preliminary injunction was brought to a close on the 7th inst. before Judge Green in the United States Circuit Court at Trenton.

THE GENERAL E. S. GREELEY glided into the water in the presence of 1,500 people at New Haven on June 5, but was promptly secured by a tug and taken to a wharf. She is a four-masted schooner of 2,200 tons burthen, and her owners feel assured that if there is anything in a name her success is assured.

MR. JOSEPH SACHS has opened an office at 32 Nassau street, New York, where he will practice as a devising and consulting engineer. His specialty will be in the application of electricity to new and special uses, designing the necessary apparatus or giving advice as to how desired results may be attained by electrical means.

THE EXCELLENCE of the Davidson steam pump, built by M. T. Davidson, Brooklyn, N. Y., is attested by the large number used by the United States Government in various situations. A recent installation consists of four Davidson pumps of special design aboard the U. S. battleship Texas, to be used for operating the hydraulic machinery of the turrets and heavy guns.

THE NORTH RIVER BRIDGE BILL has finally received the signature of the President, after passing both branches of Congress. If the undertaking is carried through, the transportation facilities to and from New York will be enormously increased. If it becomes a great passenger thoroughfare, as has the Brooklyn Bridge, it is quite possible that electricity will be adopted as a motive power.

ELECTRIC RAILWAYS AND THE CONSTITUTIONAL CONVENTION.—Mr. Andrew H. Green introduced a resolution before the Constitutional Convention reciting the desirability of a constitutional provision prohibiting free grants of franchises, and securing greater protection of cities' interests, and calling on the mayors of New York and Brooklyn for various information in regard to street railways in those cities.

ILLEGAL SUBWAYS.—At the meeting of the Board of Electrical Control last week it was said that several gas companies had been secretly laying pipes containing electrical conductors in different parts of the city in violation of the city contracts with the subway companies. The mayor offered a resolution directing the commissioner of public works to make an investigation and have the conductors taken out wherever they were found. The mayor explained that the gas companies laid their pipes at night. One of the principal gas companies of the city had been discovered laying a gas main on one of the principal avenues for the purpose of putting in an electrical conductor for its own use.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., June 9, 1894.

MALDEN, MASS.—The West End Street Railway Company has asked the aldermen for right to lay double tracks on Highland avenue, from Middlesex Fells to Wellington line.

LOWELL, MASS.—The aldermen have refused the South Side Street Railway a location to enter the city. Because of this action the directors will not press for a location in Lawrence.

THE AMERICAN CIRCULAR LOOM COMPANY, of Boston, has removed its offices from 620 Atlantic avenue to its factory, Highland and Suffolk streets, Chelsea, Mass. Its postal address is Chelsea Station, Boston, Mass.

THE HIGHAM ELECTRIC COMPANY.—The address of this company is 164 High street (Fort Hill square), Boston, where Mr. Higham, its president, will be pleased to receive all who may wish to observe and inspect its new incandescent arc lamps.

LACONIA, N. H.—By the burning of the works of the Laconia Car Company there were consumed 20 electric cars intended for the Brooklyn, N. Y., Highland street railway, and also five others, which were to be shipped on the next day to different roads.

MR. F. A. SCHEFFLER, who has been connected with the Stirling company for the last year as its sales agent in New York, has gone to Boston, where he will co-operate with Mr. J. Bradford Sargent, the New England representative of the Stirling company, in his efforts to bring the Stirling more prominently before the steam users of that section. Mr. John MacCormack, who is very well and favorably known to the boiler trade throughout the East, succeeds Mr. Scheffler as manager of the New York office of the Stirling company.

THE DAVIDSON VENTILATING FAN COMPANY, of Boston, has added recently to its list of agencies that of the Wenstrom Electric Company, of Baltimore, whose dynamos and motors it will represent exclusively in New England, and which places it in a position to enter more actively into the electric lighting and power field. This company now represents in New England the Columbia incandescent lamp, the Stanley motors and the Norwich Insulated Wire Company, aside from its regular business of ventilating fan machinery and motors. Mr. Frank B. Parsons is the manager of the company, and is a thoroughly energetic and go-lahead business man.

THE BEACON VACUUM PUMP AND ELECTRICAL COMPANY, Boston, reports an excellent demand for its incandescent lamps, and its constantly growing business has necessitated increased space in its factory. It is selling from 3,000 to 4,000 lamps every day, and is placing on the market its new 32 and 50 c. p. lamps, of all voltages, the same as heretofore. One of its specialties is the manufacture of lamps representing all the various colors of glass, with the colors lasting. The Beacon company has recently placed itself in communication with the trade using its lamps during the past season, requesting reports of any complaints regarding their operation, to which it has received numerous flattering replies, and it is desirous of hearing from others as soon as possible—complaints as well as compliments.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD
936 Monadnock Building CHICAGO June 9, 1894.

THE E. P. GLEASON MANUFACTURING COMPANY has removed its Chicago office to 183 Dearborn street, where the resident representative, Mr. F. L. Johnson, will be pleased to see his old friends.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, 1108-1110 St. Charles street, St. Louis, Mo., has issued a leaflet calling special attention to its 15-ampere knife switch, which sustains the well-deserved reputation for excellence which the goods of this company bear.

Canadian Notes.

OTTAWA, Ont., June 9, 1894.

LONDON, ONT.—A new offer has been received from the Chicago Installation Company for the electric railway franchise in this city. The offer concedes workingmen's tickets in the morning and evening at eight for 25 cents, guarantees a one, two and three percentage as before, and undertakes all risks of a lawsuit with the present company.

OTTAWA.—A bill has passed the Dominion Parliament giving the Government power to require electric railways to provide adequate shelter for their motormen. Mr. Mulock said his whole

idea was to have the motormen sheltered from the weather. The minister of railways approved of the bill. He said it was a necessity. Motormen were amply protected in Ottawa, but in some towns they were not.

MONTREAL.—The net profits of the Montreal Street Railway Company, after paying running expenses, city percentage, fixed charges, etc., as shown by the official figures for the winter six months commencing Oct. 1 last, were $70,450, an increase of $58,479.86 over the corresponding period of last year. During many previous winters the company only made expenses. The number of passengers carried in the last six winter months was 8,592,944, as against 7,240,553 during the previous winter. In March, 1894, the cars carried 1,517,880, against 1,227,115 for the same month last year. The average number carried per day in March, 1894, was 48,961, and in March, 1893, 38,984.

English Notes.

LONDON, England, May 30, 1894.

LAMP TESTS.—The lapse of the Edison lamp patent in this country has resulted, as was to be expected, in the consumers being offered lamps of all kinds and at all prices. One of our best managed electricity supply companies has decided to study its own interest and that of its consumers by acting as intermediary between lamp vendors and their unsuspecting prey. The company buys the lamps wholesale and sells them retail, testing them carefully en route. Already some interesting facts have come to light. English makers, it seems, are unable to cut off eight candles with any tolerable degree of accuracy; Continental makers, on the other hand, are able to do this and also to insure their watts per candle being somewhere near the mark, at any rate, at the start. Unless the home-made product either shows a longer life or a greater constancy of candle power and "wattage," it will be yet another case of our being beaten on our own ground.

THE COST OF ELECTRICAL ENERGY.—The discussion on Mr. Crompton's paper on the "Cost of Electrical Energy" came to a conclusion last Thursday; Professors Unwin and Kennedy, Mr. Druitt Halpin, of hot water storage fame, and Mr. Rosenthal, of the Babcock-Wilcox company, taking part. Professor Unwin gave some results of tests of Lancashire boilers, which showed an evaporative efficiency of 11.87 pounds of water, and generally traversed Mr. Crompton's appreciation of the water tube type of boiler and his depreciation of North country or bituminous coal. Professor Unwin also gave some valuable facts with regard to the use of superheated steam in Alsace. In one case a 500-h. p. compound engine used superheated (520 degrees) steam without any injury to the cylinders, and with an economy of 20 per cent. Professor Kennedy stated that the Westminster company, with which he is connected, had brought down the coal (Welsh) consumption per unit generated to 4¼ pounds, and he was prepared to predict a future consumption of only 3.64 pounds per unit sold. He also stated that exhaustive tests were being carried out in Belgium with a view of exactly ascertaining the losses involved by rope and belt driving. Discussing the much debated question of small central and big "peripheral" stations, Professor Kennedy pointed out that after a certain size, say 3,000 h. p. to 4,000 h. p., had been reached, it mattered not from the point of view of operating costs whether one large or several small centres were adopted. Mr. Crompton in his reply admitted the good performances of the Lancashire boiler under normal conditions, but pointed out how abnormal were the conditions of central station work. He concluded by emphasizing the value of oil-fired boilers as a standby, to contend with the heavy loads so often thrown upon a station in the day time without any warning, and lasting only for half an hour or so.

News of the Week.

Telegraph and Telephone.

MINNEAPOLIS, MINN.—The Council decided to advertise for telephones for the police signal service, as the city thinks it is paying too high a rate at present.

COVINGTON, KY.—The City Suburban Telephone Company has petitioned for right to erect poles and string wires within the city limits. The matter was referred to the committee on law and the city solicitor.

GREAT BARRINGTON, MASS.—The new telephone exchange will be under the management of the recently organized electrical firm of Evans & Whitwell, and will pass under their control on its completion, in a few weeks.

PHILADELPHIA, PA.—Mr. Klemmer introduced an ordinance granting permission to the Mutual Automatic Telephone Company to construct manholes, cables, wires and terminal for electrical purposes. The bill was referred to the electrical committee.

Electric Light and Power.

HOUSTON, TEX.—Address J. T. Browne, mayor, concerning the electric lighting contract.

HAMILTON, OHIO.—An election is to be held to vote on issuing $50,000 in electric light bonds.

CARDINGTON, OHIO.—The city voted to issue $25,000 in bonds for electric lights and street paving.

NEW BREMEN, OHIO.—An election will soon be held to vote on the issue of $10,000 in electric light bonds.

EL PASO, CAL.—J. R. Perry can give information concerning an electric lighting system, which is to be established there.

ESTHERVILLE, LA.—An election will be held June 14 to vote on the question of issuing bonds for waterworks and electric lights.

BUFFALO, N. Y.—The Works of the Warren Gaslight and Electric Light Company were destroyed by fire on June 3. The loss is $6,000.

WARREN, PA.—The plant of the Warren Gas and Electric Light Company has been burned, with a loss of $20,000. It will be rebuilt at once.

BALTIMORE, MD.—The Brush Electric Light Company has issued $3,154,000 in bonds for the purpose of rebuilding its works destroyed by fire last October.

SHENANDOAH, PA.—Several prominent Main street merchants and a number of leading citizens are said to be projecting a new arc and incandescent electric plant.

THE CLEAR LAKE (IA.) ELECTRIC LIGHT AND POWER COMPANY has secured an exclusive franchise for 20 years from the city of Clear Lake. It will do the city lighting. Mr. John L. Etzel is president of the company.

BEVERLY, MASS.—The aldermen have refused the Common Council a representation on the committee to make a new electric light contract; the Council proposes to even up by refusing to vote any appropriations where they are not consulted.

BROCKTON, MASS.—The City Council has offered the Edison company $90 a year for a 1,200-c. p. arc light and $14 for a 16-c. p. incandescent light on a five year contract. The city will also purchase an engine and dynamo for a plant to light the hall.

BOONSBORO, MD.—A special election was held June 8 to determine whether the town shall issue $15,000 in bonds and subscribe that amount to the capital stock of the South Mountain Electric Light and Power Company. There is bitter opposition to the project.

BRUNSWICK, MO.—W. H. Finch, city clerk, may be addressed in regard to the proposed erection of an electric light plant, including one 60-h. p. engine, two 18-kw. incandescent dynamos, switchboards and fixtures, fifteen 2,000-c. p. arc lamps, two miles of circuit, three-wire system, etc.

MONTROSE, PA.—Daniel Killion, representing the Pennsylvania General Electric Company, of Philadelphia, was in town recently to confer with the borough officials in regard to an electric light plant. If the borough puts in a plant of its own, the Pennsylvania company expects to bid on the contract.

GENESEO, N. Y.—The Geneseo Gas Company has commenced the erection of a building for the electric light plant on School street. The lot fronts 150 feet. The building will be of brick, with slate roof, and fireproof. It will have two stories, 75 by 31 feet, and contain offices, engine and dynamo room, etc.

OYSTER BAY, N. Y.—At the meeting of the Town Board on June 2 an application was presented by the Electric Light and Power Company for the lighting of the streets of the village. The petition was signed by a large number of business men. The board has called another meeting for June 9, when the matter will be determined.

HARLEM, ILL.—Sealed proposals will be received until June 16 for furnishing and putting in place a dynamo, switchboard, engine, boilers, wires, poles, electric conductors and appliances according to plans and specifications in the office of the village clerk. Proposals will be received for the whole or any part of said electric lighting system. Henry C. Meier is village clerk.

ROCHESTER, N. Y.—The Niagara Falls Power Company will soon be formed in this city by Frank W. Hawley. The local directors of the concern will be Mayor G. W. Aldridge and Henry C. Brewster. The other directors will be Thomas C. Platt, Frank W. Hawley and William Mertens. The amount of the capital stock has not yet been definitely determined.

PITTSBURGH, PA.—At a recent meeting of the Allegheny public works committee bids were opened for building an addition to the Braddock avenue light plant. The lowest one was $25,893, and Director McAfee said this was too high by $6,000; a sub-committee was appointed to trim the plans down to a reasonable figure, when bids will be again asked. A new electric railroad scheme is on foot to open up additional territory in the East End, across the river to Homestead. Ordinances to secure the necessary authority are being prepared for presentation to councils.

EVANSTON, ILL.—The committee on lighting recommended that the proposals opened at a meeting of the Council, held April 24, for furnishing a new electric light machine for the city's plant in the third ward be rejected and the deposits returned; also that the commissioner of the public works be directed to re-advertise for proposals for furnishing one and two new 50-light dynamos, and to word the advertisement so as to include proposals that may be received from owners of dynamos that were in use in connection with the World's Columbian Exposition.

The Electric Railway.

HARTFORD, CONN.—Engineers are surveying a route for a new electric line to Windsor.

COHOES, N. Y.—Citizens are agitating the question of the local electric street car line.

LORAIN, PA.—The Hon. Tom L. Johnson will build an electric railway line in Lorain.

PHILADELPHIA, PA.—The Electric Traction Company will extend its Fifth and Sixth street lines.

NANTICOKE, PA.—Work on the proposed electric road to Glen Lyon will be commenced in about two months.

MEMPHIS, TENN.—The Citizens' Street Railway Company has made preliminary surveys for an electrical railroad to Binghamton.

VICKSBURG, MISS.—The Vicksburg Electric Transit and Lighting Company will shortly begin work on its electric railroad.

UNION BRIDGE, MD.—It is proposed to construct an electric railway from Washington Grove to Sandy Spring, in Montgomery County.

BRADFORD, PA.—An ordinance granting a franchise to the Bradford and Kendall Railway Company was referred to the street committee.

NEW BRUNSWICK, N. J.—There is some displeasure at the refusal of the Common Council to encourage an electric road for New Brunswick.

THE ATLANTA TRACTION COMPANY has been placed in the hands of permanent receivers. T. B. Rossers and W. C. Haile are the receivers.

NEW BRITAIN, CONN.—The Central Railway and Electric Company is considering plans for a belt line in the eastern portion of the city.

PHILADELPHIA, PA.—The United States has lost its suit to prevent the Gettysburg Electric Railway from building a branch trolley line to "Round Top."

ALLENTON, PA.—The Inter-County Electric Railway Company is looking for a route to Mauch Chunk, and is likely to get control of the Mauch Chunk Railway.

BEDFORD CITY, VA.—A meeting was held Saturday in the interest of the electric road that it is proposed to build from Lynchburg to Bedford City. Mr. H. Hogan, of Burton's Creek, was the secretary.

PHILADELPHIA, PA.—Ordinances granting the Citizens' Clearfield and Cambria Railroad Company and the Citizens' Passenger Railway Company the right to lay tracks and use electric motors were passed.

BROOKLYN, N. Y.—The Coney Island Railroad Company, an organization composed of citizens of Gravesend, has determined to construct a trolley line along Surf avenue to Gravesend, from West Brighton to Sheepshead Bay.

HOBOKEN, N. J.—A mass meeting was held in the Hoboken city hall protesting against the privilege being granted to the Jersey City, Hoboken and Rutherford Electric Railway Company to lay tracks through First street.

BROOKLYN, N. Y.—The Brooklyn City Railroad Company is seeking to extend its trolley line, and is meeting with some opposition by the Coney Island, Fort Hamilton and Brooklyn Railroad Company, which desires the same privilege.

NEW YORK, N. Y.—The promoters of the White Plains, New York and Mamaroneck, and the New York, Elmsford and Silver Lake railroads, to be operated by electricity, are anxiously awaiting the granting of a franchise by the board of trustees.

LAWRENCE, MASS.—The Lawrence, Lowell and Haverhill Street Railway Company has begun the work of extension of its line through Lowell, Milton and Haverhill streets to Barker's grove. The present intention is to have the line completed by July 1.

PHILADELPHIA, PA.—The Councils' committee on street railways has agreed to report favorably upon the bill for the construction of the Brown and Parrish street electric railway. The East End passenger railway bill was also reported favorably.

HAMMOND, IND.—A project is on foot to run an electric street car line through West Hammond and Burnham, and to make connections with the Calumet Electric Railway; this arrangement would land passengers in the heart of Chicago in less than an hour's time.

SAGINAW, MICH.—The Union Street Railway Company will soon commence the erection of its power house. The plant will be located on South Tilden street, one block north of the Everett power house. It will be equipped with all modern apparatus, and will cost $25,000.

SINKING SPRING, PA.—Citizens of Sinking Spring voted in favor of granting right of way for an electric road from Reading to Womelsdorf, but were opposed to connecting the Reading and Southern Railroad at Shillington, desiring the road to run direct to Reading.

BLOOMFIELD, N. J.—Samuel Moore, of Bloomfield, has obtained the signatures of many of the citizens of that town in favor of the use of electricity on the Suburban Traction Company's lines. He will present the petition to the township committee at its special meeting next Saturday night.

BALTIMORE, MD.—The commissioners of Baltimore County have granted permission to the Canton, Sparrow's Point and North Point Railway Company to lay tracks on certain streets and roads, and to build an elevated structure on Clinton street, provided the road cannot be constructed otherwise.

AMSTERDAM, N. Y.—Lawrence Caten, of Gloversville, has been visiting Amsterdam in the matter of the proposed electric road between Akin and Fulton. Among those interviewed was Civil Engineer Moak, but the latter will make no definite statement, stating merely that the road will eventually be built.

LANCASTER, PA.—A charter was granted by the State Department for the Mohnsville and Adamstown Railroad Company, with a capital stock of $75,000, to run from Mohnsville, Berks County, to and through the borough of Adamstown, Lancaster County, a distance of 7½ miles. L. T. Custer is president.

DETROIT, MICH.—The company that proposes to build an electric railway between Port Huron and Lexington has filed articles of incorporation. It is capitalized at $200,000, the incorporators being Edgar A. Brennan and T. W. Bainbridge, of Toledo, and William C. Maybury, George Schaffer, William Nichols and C. W. Harrah, of Detroit.

AMSTERDAM, N. Y.—There is a project on foot to build an electric road between Richfield Springs and Oneonta, a distance of 34 miles. The cost is estimated at $7,000 a mile. The road will, if constructed, carry freight as well as passengers, and have stations at Schuyler's Lake, Oakville, Hartwick, South Hartwick, Mt. Vision and Laurens.

LOCKPORT, N. Y.—Mayor Atwater has received word from Reed & McKibbin, contractors of the Lockport electric railway, that they will deposit $5,000 with the city treasurer as a guarantee that they will have the electric road in Lockport running by Sept. 1, 1894, if an extension of time is granted them to that date. The time has been granted.

RANDALLSTOWN, MD.—James G. Floyd, representing the Barrows Electric Street Car System, of which C. H. Barrows, of Willimantic, Conn., is the inventor, has made application to the officers of the Randallstown, Harrisonville and Granite Rapid Transit Company to build and equip the road with the barrows system, and the petition will be considered at a meeting to be held this week.

BUFFALO, N. Y.—The Crosstown Street Railway Company, of Buffalo, has made application to the Common Council of the city of Buffalo for permission to construct, extend, maintain and operate a street surface railroad, to be operated by electric power over, along, under and upon Hertel avenue, easterly from Elmwood avenue to Main street, so as to connect with the railway tracks in Main street.

BROOKLYN, N. Y.—The highway commissioners of Jamaica, at a meeting June 3, granted to the Long Island Electric Railroad a franchise to lay tracks on New York avenue and Rockaway road within the town limits. A similar franchise for Liberty avenue was granted the same company a short time ago. The granting of these franchises is the preliminary step to the construction of a trolley road from Brooklyn to Hempstead.

HOMESTEAD, PA.—The Homestead and Highland Street Railway Company has resumed work, and it is thought cars will be running by fall. The street railway company recently entered into a contract with Mr. Brown to cross the bridge with cars. Work on the Brown bridge, which spans the Monongahela River from Brown's Station, on the Baltimore and Ohio Railroad, to Ann street, Homestead, has also been resumed.

Miscellaneous Notes.

ACROSS THE OCEAN IN A SECOND.—The result of the Derby race was received by the United Press from the office of the Direct United States Cable Company just one second after it was filed in London.

MR. CHAS. G. ARMSTRONG recently read a paper before the Chicago Electrical Society on "Street Lighting by Alternating Arcs," which predicts that alternating arcs will become largely used for street lighting on account of their superior efficiency.

THE RICHMOND ELECTRIC CLUB, of Richmond, Va., has been formed, and has the best wishes of The Electrical World for its success. The officers are Geo. A. Tower, president; T. L. Martin, vice president; Harrison Tabb, secretary; F. J. Craigie, Jr., treasurer. The executive committee consists of Messrs. Maurice W. Thomas, Henry E. Tresnon, Harry D. Winn and Charles P. McCluer.

PURDUE UNIVERSITY, through the untiring efforts of its president and the co-operation of the faculty and board of trustees, has so far repaired the loss which its magnificent new engineering laboratory suffered recently from fire, that after Sept. 15 next the regular engineering work of the University will not be embarassed. Not only has a complete restoration of all that was lost been provided for, but many additions are to be made, so that the laboratory will be better equipped than ever for work in all the departments of engineering.

THE EDITOR, THE ELECTRICIAN AND THE COUNCILMAN.—A Western newspaper has the following: "The acting city electrician is full of volts, amperes, ohms and all that sort of electrical gibberish, but all this scientific gabble does not prove him to be an expert electrical engineer qualified to make chemical and electrical tests that require years of special training. The most

amusing part of all these mummeries are the learned disquisitions of that eminent glass insurance scientist, Councilman Wheeler. What Wheeler does not know about electrics would eat through several 24-inch water mains, and pass through all the gas pipes from Alpha to Omaha."

TROLLEY PATENT SUITS.—The Westinghouse Electric and Manufacturing Company has filed an answer in the United States Circuit Court in the trolley patent suits brought by William M. Schlessinger for himself and as trustee for Susan McDuffee and Albert H. Williams, against the Philadelphia Traction Company and the Westinghouse company. In the answer the Westinghouse company denies that Schlessinger was the first inventor and that he is entitled to the exclusive use of the invention and improvements. Regarding one of the patents, it is asserted in the answer, on information and belief, that Schlessinger surreptitiously or unjustly obtained it for what was in fact invented by others who were using reasonable diligence in perfecting and adapting the same. The inventors referred to are Thomas A. Edison, Hiram S. Maxim, Frank J. Sprague, Leo Daft, Charles J. Van Depoele and John C. Henry.

THE NATIONAL SCHOOL OF ELECTRICITY.—We have received a communication from Prof. J. P. Barrett stating that the members of the faculty of the National School of Electricity are now actively engaged in the work of preparing the educational course. Every lesson, after its preparation by some member of the faculty, is sent to, and is to have, the approval of the other members before it is published. The course is to be of a practical nature, and the management of the school makes no promise to fit students for expert electrical service after taking the course. The prospectus issued states specifically that taking the course will not fit any one for expert service. It is intended, however, to be sufficiently elementary and exhaustive to give students an insight into the science, and to introduce them, as it were, to the subject in a way that will permit them to prosecute its study in an intelligent and comprehensive manner, and if taken in connection with either practical or theoretical work, will aid them in their attempt to master the subject. The course is to be practical to the extent that apparatus is to be employed in the demonstration of principles and in full explanation of theories and practice. The particular member of the faculty who writes a particular lesson specifies at the end of the lesson the apparatus required, and particularizes as to its use. The apparatus called for is to be invariably provided and employed. It may serve for fuller information in regard to the details of the operation of the school to give a few of the facts concerning the organization of classes in Chicago, where a most promising commencement has been made. There are now organized for work nine classes, and new classes are being organized almost every night. These classes contain from 30 to 75 members. They meet one evening in each week. The instructors are young men thoroughly familiar with the theoretical side of the subject by virtue of college courses, and who have had practical experience in the laboratories and factories, and in commercial positions in the large companies. The best people, and those most competent to judge of the probable usefulness of this course, are stated to be actively interested in its success in Chicago, and have made personal efforts to that end. Bishop Fallows gave the weight of his influence in behalf of the organization by presiding at a meeting for the organization of the first class. The management of the Armour Institute have supported the movement to the extent of identifying the school with the electrical department of that institute, by inviting the organization of a class in the institute, and by active co-operation towards its success. Professor Stine, professor of electrical engineering of the institute, will personally direct the course of instruction, and will aid in every way the success of the undertaking. It has been the intention to feel carefully the way before prosecuting the work of organization of classes outside of Chicago, with a view to the perfection of details. It is now the intention to vigorously prosecute the work in all of the states of the Union.

Trade and Industrial Notes.

THE IOWA ELECTRIC AND CONSTRUCTION COMPANY, Des Moines, Iowa, has closed a deal by which it has obtained the exclusive franchise for an electric plant at Eagle Grove, Iowa, upon which work is already commenced.

HUEBEL & MANGER, manufacturers of electrical goods, 286-290 Graham street, Brooklyn, report business very good. They have been receiving large orders of late for their improved style F iron frame pivoted armature bells. They are being used extensively in hotels, factories and large buildings for fire alarm and other purposes where a good reliable bell is needed.

THE WALLACE ELECTRIC COMPANY, Chicago, has in preparation a folder describing the various styles and sizes of fan motors which they are now handling. This folder will contain a full description of direct and alternating current motors, battery fan motors and exhaust fan motors. This latter motor is made with a 24-inch fan, and is the only motor of its kind now on the market swinging a 24-inch blade.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is calling prominent attention to the fact that the wonderful effects in fancy illumination which form such an attractive feature of the Masonic Temple Roof Garden and Scenic Theatre are produced entirely by Packard lamps furnished by the Electric Appliance Company. Several thousand Packards of all sizes, shapes and colors are used in producing the beautiful effects.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued a catalogue of its fan motors for the present season, which shows that important improvements have been made in interior details. One of the features of these motors is that the speed of the fan can be both regulated and reversed, the former by merely shifting a regulator stud projecting through the front, and the latter by reversing the position of the stud.

THE SHERBORNE ELECTRIC INSTALLATION AND DORSET POLYTECHNIC COMPANY, Dorset, England, sends us circulars describing the Sherborne combination engines and dynamos, and an electric bicycle lamp. The former are from 4 to 12 lamps capacity and portable. The lamp and lantern weigh five ounces and storage battery 1 pound 5 ounces for seven lamp hours, and 2 pounds 12 ounces for 20 hours.

THE GEORGE L. COLGATE COMPANY, 136 Liberty street, New York, recently incorporated by George L. Colgate, well known in electrical circles, reports that it has received several nice orders lately for the various specialties it is handling. Its latest acquisition is the purchase from Mr. W. A. Vail of all rights, titles and interest in his swinging ball lightning arrester. This company also handles the Star electric moulding, the McIntosh insulating paint, the Whitney instruments, the McNutt lamp, Simplex wire and a general line of supplies.

CHAS. A. SCHIEREN & CO., 45 Ferry street, New York, report that trade has been quite good of late, there having been quite a demand for the best grades of leather belting. They are now making two 28-inch double belts for Newark, N. J.; two 18-inch double belts for the Geneva Brush Electric Company, Geneva, N. Y.; two 22-inch double belts for Brooklyn; two 54-inch double belts for the Allentown Traction Company, Allentown, Pa.; two 54-inch belts for the City and Suburban Railway Company, Baltimore, Md. Two 32-inch double belts have been shipped to the Richmond (Ind.) Light, Heat and Power Company, and a 50-inch double belt—second order—for the Steinway Railway Company, Astoria, L. I.

E. P. ROBERTS & CO., Cleveland, Ohio, have obtained the services of Mr. W. B. Stewart as a partner in their firm. Mr. Stewart has had 29 years' practical experience in steam engineering and general machinery, and eight years in electric light and electric railroad work. He is an exceptionally fine machinist, and the firm considers itself very much strengthened by the addition. The consulting business of this successful company is at the present moment flourishing; 10 engines and dynamos are being placed under their specifications and awaiting their tests, as well as several boilers and some miscellaneous machinery; also the preliminary estimates for a 30-mile electric road and a number of wiring plans, one of their specialties, the mechanical and electrical design for a 15-ton elevator and of some special machinery, and two legal cases, for which they are technical experts.

THE ELECTRIC STORAGE BATTERY COMPANY, Drexel Building, Philadelphia, announces that after a series of exhaustive tests covering a period of six months, conducted at the Edison laboratory by Mr. W. K. L Dickson, Mr. Edison's consulting electrical engineer, the chloride accumulator has been adopted exclusively for operating the Edison kinetoscope. The following is Mr. Dickson's letter announcing the result of his test: "At your request it gives me great pleasure to state that after testing the leading makes of storage batteries in connection with the Edison kinetoscope, I have given the preference as to capacity, mechanical construction and durability to your chloride accumulator, which stands unique among its competitors, marking an important stride in the right direction, and being capable of application to varied uses."

THE COLBURN ELECTRIC MANUFACTURING COMPANY, Fitchburg, Mass., has supplied dynamos for the following plants recently installed by the Missouri Electric Repair Company, 16 South Ninth street, St. Louis: One 50-light incandescent dynamo for the Victoria Flour Mill Company, St. Louis, Mo.; one 100-light incandescent dynamo for the J. L. Ennis Candy Company, St. Louis, Mo.; one 100-light incandescent dynamo for the E. O. Stanard Milling Company, St. Louis, Mo.; also one 100-light incandescent dynamo for the E. O. Stanard Milling Company, Alton, Ill.; one 40-light incandescent dynamo for the Alton (Ill.) Roller Milling Company; two 350-light incandescent dynamos for the Nicholson Hotel, Nashville, Tenn.; one 80-light incandescent dynamo for the C. C. Shelton Milling Company, Chattanooga, Tenn. These dynamos, Mr. Tyler states, are remarkable machines. They are of very high efficiency, and will carry a load of 15 per cent. more than their rating. When full load is on the dynamo the brushes can be rocked for a space three-quarters of an inch without sparking at the commutator in the slightest degree or the voltage changing, and they regulate within 2½ per cent.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

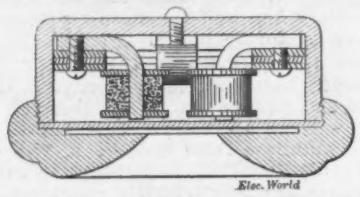
OPEN AND CLOSED CIRCUIT CELLS.—The Hayden carbon porous cup No. 1 cell; the Hayden carbon porous cup No. 2 cell; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient, and at prices lower than ever. THE HAYDEN-BOOKER MANUFACTURING COMPANY, 2140 DeKalb St., St. Louis, Mo.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED MAY 29, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

520,406. MAGNETO TELEPHONE; A. F. Boardman, Somerville, Mass. Application filed March 24, 1894. A casing for a ring magnet, combined with a magnet by means of a non-magnetic yoke whose ends engage the ring magnet secured at its middle to the casing. (See illustration.)



NO. 520,406.—MAGNETO TELEPHONE.

520,412. INSULATOR; C. E. Conover, Cincinnati, Ohio. Application filed May 20, 1893. In an insulator, a line wire groove transversely thereof, two bends, and a groove arranged diagonally with the line wire groove and leading outward from it to the end of the insulator and forming thereby ears, one at each end of the line wire groove for retaining the line wire therein.

520,427. CIRCUIT CLOSER; G. W. Hey, Syracuse, N. Y. Application filed March 11, 1893. This comprises a lever provided with one of the terminals of an electric circuit, a second lever provided with the other terminal of the electric circuit, and a connection between the levers connected to one of the levers with a lost motion.

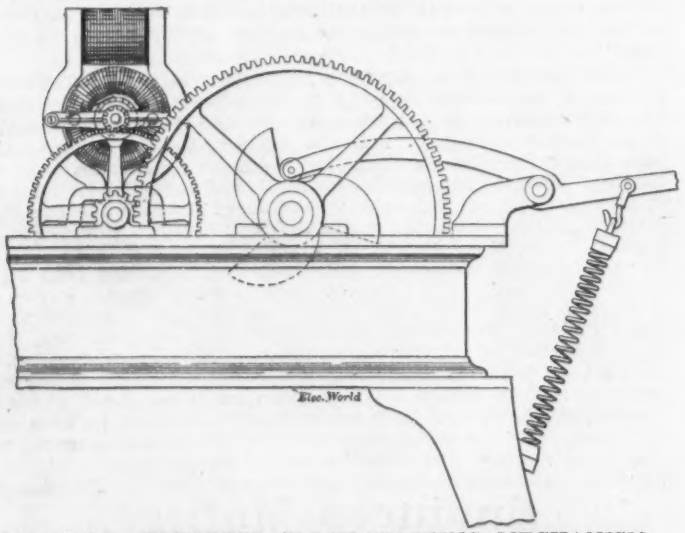
520,429. ELECTRIC BATTERY; S. H. Hoggson, St. Louis, Mo. Application filed March 6, 1893. In a battery having cells arranged in series and connected by adjacent terminals, the combination of a spring clamp, a coil above the clamp, and the terminal of an adjoining cell.

520,445. ELECTRIC CIGAR LIGHTER; D. Misell, New York, N. Y. Application filed Dec. 5, 1893. The combination of a battery jar with a spring plunger, a zinc element secured thereto, a pair of battery wires, an incandescent coil and a guard provided with an opening and with a socket back of the opening.

520,467. SPEAKING ATTACHMENT FOR TELEPHONES; W. Weber, Philadelphia, Pa. Application filed Feb. 15, 1894. This comprises a flexible speaking tube, a rigid arm, and means to hold the delivery end of the flexible tube contiguous to the transmitting diaphragm.

520,474. SWITCH; H. P. Ball, Bridgeport, Conn. Application filed March 12, 1894. This comprises a piece of sheet metal bent upon itself to form a switch blade, two sides of which are connected by a loop or fold, and a handle secured to the switch member by a single pin passing through the loop.

520,520. SAFETY SYSTEM FOR RAILROADS; W. H. Elkins, Cambridge, Mass. Application filed Oct. 22, 1892. This consists of a circuit closed by the presence of two trains on the same track, the resistance of the circuit varying as the trains are closer together and containing translating devices adjusted to translate a given current into a signal.



NO. 520,585.—ELECTRIC CLOCK-STRIKING MECHANISM.

520,543. TESTING SYSTEM FOR MULTIPLE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. Application filed Aug. 24, 1891. A responsive device for test circuits, an electromagnet having a coil included in the test circuit, in combination with a transmitter having a diaphragm of magnetic material adapted to vibrate against the pole of the magnet, the contacts of the transmitter being included in a local circuit with a battery and a coil adapted to act inductively upon the circuit of a telephone.

520,547. FIRE ALARM APPARATUS; F. J. Thunhorst, Allegheny, Pa. Application filed Feb. 26, 1894. The combination of an electric signal, a spring arm, a wire secured to the arm and to a fixed support, a series of tension cords of inflammable material engaging the wire, inflammable cords connecting the tension cords, and non-combustible links between the ends of the connecting cords.

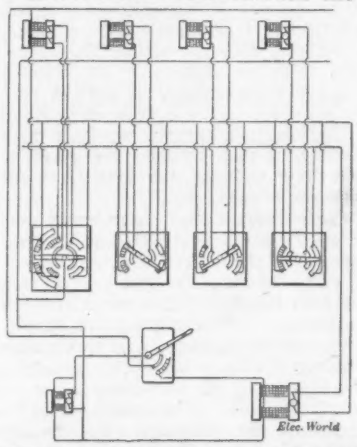
520,585. ELECTRIC CLOCK STRIKING MECHANISM; C. D. Warner, Ansonia, Conn. Application filed April 6, 1893. The combination of a bell hammer actuating device, an electric motor and its circuit for operating the device, a time circuit armature acting to close the motor circuit, and a locking device acting to hold the armature in closed circuit position during the time of striking. (See illustration.)

520,602. INSULATOR; H. H. Luscomb, Hartford, Conn. Application filed March 19, 1894. This comprises a metallic case, insulating material therein, and the case having an inturned lip at its lower edge in contact with and forming a protection for the lower edge of the insulating material.

520,606. INSULATOR; L. McCarthy, Boston, Mass. Application filed Sept. 23, 1892. This comprises a case, a connecting piece therein and insulating material to insulate it therefrom, and a cap secured in place by bending the edges of the case over the cap, the connecting piece being provided on that portion which is outside the case with a shoulder.

520,614. ELEMENT FOR SECONDARY BATTERIES; S. A. Rosenthal and V. C. Doubleday, London, England. Application filed Dec. 5, 1892. This comprises a corrugated plate provided with a connecting tang, an active material, and an inclosing casing or box.

520,620. ALTERNATING CURRENT MOTOR; W. Stanley, Jr., Pittsfield, Mass. Application filed Feb. 1, 1894. This comprises a compensating synchronous motor having a plurality of circuits corresponding to and connected with those of the working motor, and clutch mechanism between the motors.



NO. 520,748.—METHOD OF OPERATING ELECTRIC MOTORS.

520,661. ELECTRIC RAILWAY SIGNAL; C. Selden and H. V. Riley, Baltimore, Md. Application filed Feb. 16, 1894. This comprises two pairs of magnets oppositely arranged, the armatures thereof connected together, the armature of one pair adapted to be polarized during the energization of the magnets controlling the same, whereby upon the simultaneous energization of both magnets a bias is created in favor of the magnet operating the polarized armature.

520,673. THERAPEUTIC ELECTRODE; W. B. Farrar, Greensborough, N. C. Application filed April 5, 1894. An electrical apparatus comprising a supporting base having plate electrodes and a stand supporting the hand electrodes, said stand being detachably mounted on the base.

520,710. ELECTRIC RAILWAY SIGNAL; C. Selden, and H. V. Riley, Baltimore, Md. Application filed Feb. 16, 1894. This comprises two oppositely arranged magnets, the winding of one magnet being a continuation of the winding of the other, two armatures moving in unison, and a locking device for holding the armatures in position.

520,737. TROLLEY WIRE SUPPORT; B. J. Jones, Sioux City, Iowa. Application filed Feb. 5, 1894. This comprises a triangular supporting piece adapted to fit a bend in the trolley wire, its outer surface being on a plane with the wire, in combination with a bridge piece, a stirrup strap and means for adjusting the stirrup strap.

520,748. METHOD OF OPERATING ELECTRIC MOTORS; J. S. Bancroft, Philadelphia, Pa. Application filed Dec. 10, 1892. A rheostat switch regulating current to the field of the generator, a rheostat switch admitting current of a constant potential to the field of a motor, in combination with an interlocking device between the two switch levers. (See illustration.)

520,758. CONDUIT RAILWAY TROLLEY; W. Lawrence, New York, N. Y. Application filed Aug. 17, 1892. A plate formed in parts, insulating material around the same, a casing binding the parts together, and arms pivoted to one of the parts, the arms having contact wheels journaled therein.